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San Bernardino Subdivision Pathing Study

Draft Final Report

DB E.C.O. North America, Inc. | January 2022

Summary

Context

In 2019, mixed traffic operations caused large inefficiencies and the BNSF effectively ran a two-track freight operation

Continuing three-track mixed operations has little growth potential on the current corridor due to infrastructure and operating limitations.

The San Bernardino Subdivision is projected to support 2% freight growth and new passenger services over the next 20 years.

There is a long list of projects to support service growth, but their impact on operations and phasing is not clear.

Method

The San Bernardino Study applies a new market-place framework to prioritize capital projects by the capacity improvements that they deliver. The study used the framework to assess which projects, in which order would support the desired levels of service on the San Bernardino Subdivision. The market-place framework defines a standard train metric to measure corridor capacity through train paths.

Like gridlines on paper, the train paths visualize capacity supply to assess utilization and frame benefit and trade-off discussions. The method enables management to compare operating data against the capacity metric and understand capacity utilization.

Results

The BNSF has recommendations and phasing plans to transform the corridor from mixed-traffic to traffic-separated over a 10–15-year planning horizon.

1. Signal upgrades represent the most effective method to increase mainline throughput: a 5-minute headway reduction raises mainline capacity by 50%

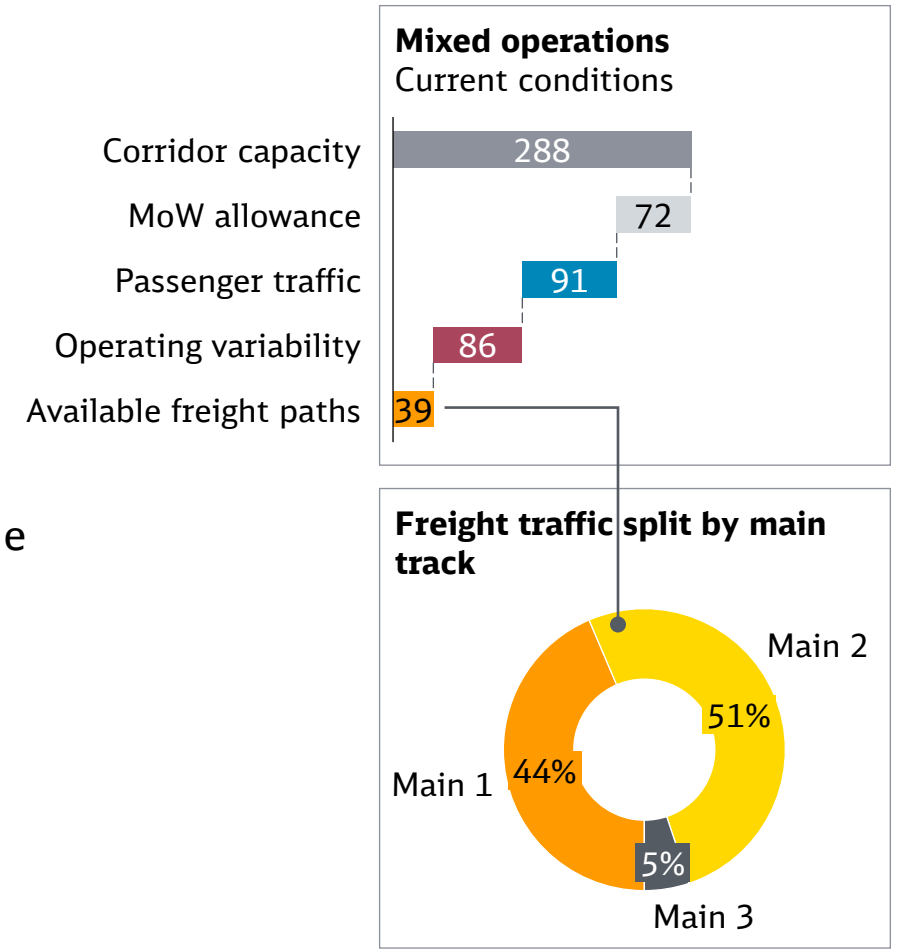
2. Terminal and mainline interface upgrades at Hobart and Commerce facilities enable trains to land and be processed without blocking the mainline

3. Traffic flow separation through targeted mainline improvements at stations and passenger service harmonization

4. Freight trains stage at Lenwood when awaiting entry windows into the terminals at Hobart and Commerce

Context

In 2019, mixed traffic operations caused large inefficiencies and the BNSF effectively ran a two-track freight operation.



Insights

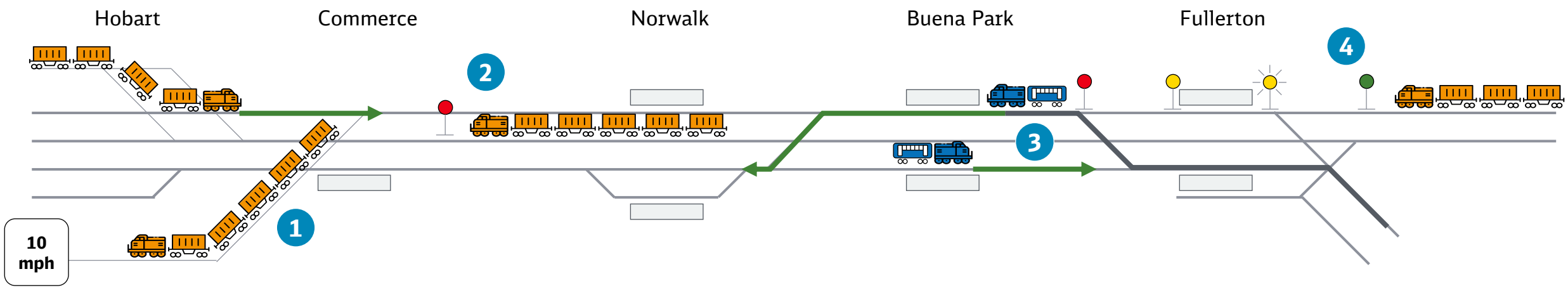
2019 passenger operations required all three mainlines and consumed 50% of mainline capacity[1]

Yard-lead movements & freight staging consumed 30% of capacity

95% of freight traffic operated on Mains 1 and 2

(1) BNSF advised that a 6-hour maintenance of way window should be assumed. Insight calculations are based on 216 available train slots

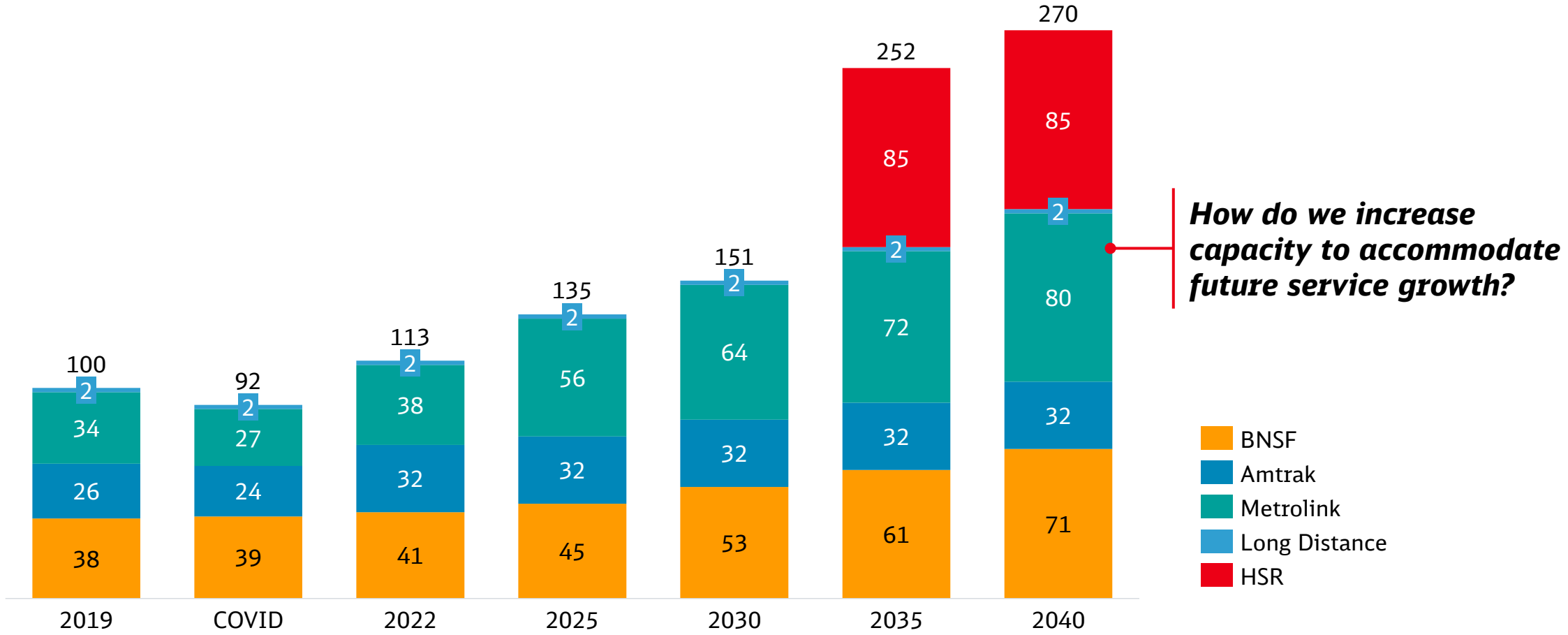
Continuing three-track mixed operations has little growth potential on the current corridor due to infrastructure and operating limitations



1. ***Terminal traffic blocks mainline flows***
2. ***Staging and junction movements block the mainline for extended periods of time***
3. ***Uncoordinated passenger schedules use track space inefficiently***
4. ***Signal system governs throughput on the mainline***

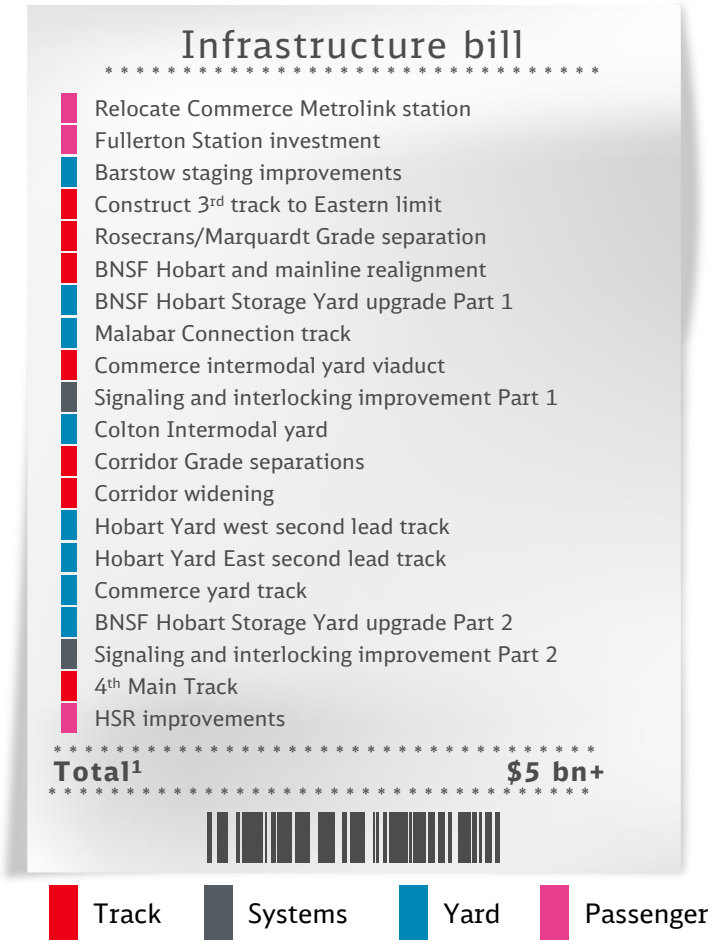
The San Bernardino Subdivision is projected to support 2% freight growth and new passenger services over the next 20 years

Projected train counts between CP Soto – Fullerton



Data sources: BNSF RTC train counts, HSR 2020 Draft Business Plan, LOSSAN 2020 Business Plan, Metrolink Service Expansion Schedules

There is a long list of projects to support service growth, but their impact on operations and phasing is not clear



How is rail capacity defined?

Train	Length	Weight	Power		
Infrastructure	Tracks	Grade	Junctions	Signals	Yards
Operations	Number of train movements	Terminal operations			
	Freight cars transported per time period	Average speed of service			
	Tons of freight transported per time period	Stability of the operations			

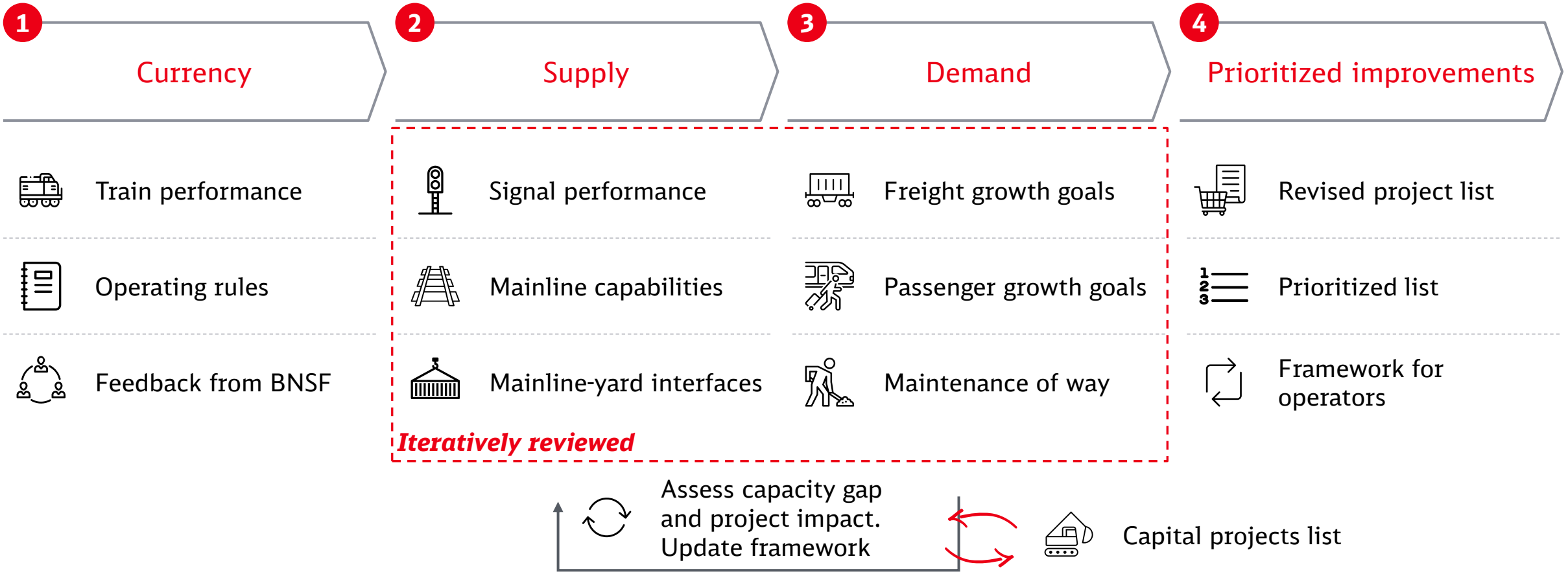
We need to set a currency for capacity

(1) Based on HSR's 2020 Capital Cost Basis of Estimate Report

Method

The San Bernardino Study applies a new market-place framework to prioritize capital projects by the capacity improvements that they deliver. The market-place framework defines a standard train metric to measure corridor capacity through train paths. Like gridlines on paper, the train paths visualize capacity supply to assess utilization and frame benefit and trade-off discussions. The method enables management to compare operating data against the capacity metric and understand capacity utilization. The framework assesses which projects, in which order would support the desired levels of service on the San Bernardino Subdivision

The San Bernardino Study applies a new market-place framework to prioritize capital projects by the capacity improvements that they deliver



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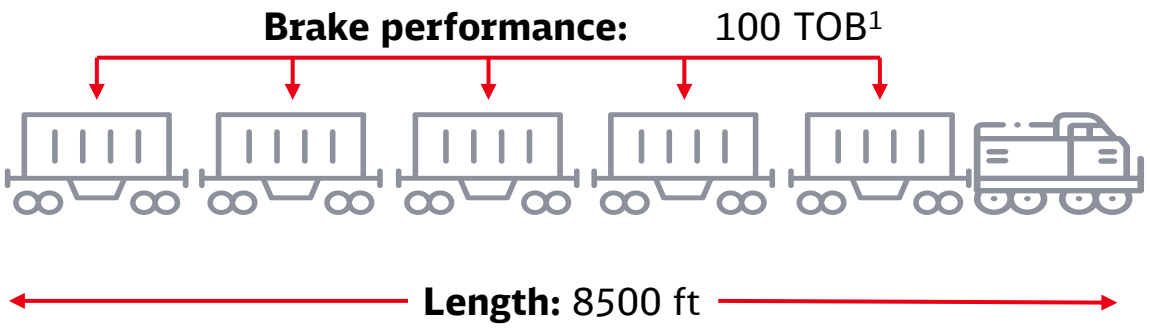
The market-place framework defines a standard train metric to measure corridor capacity through train paths

Service characteristics

Operating rules

Historic data



Power: 3 HPT[2]

Speed: 50 mph

Capacity unit

(1) Tons per operative brake (2) Horsepower per ton

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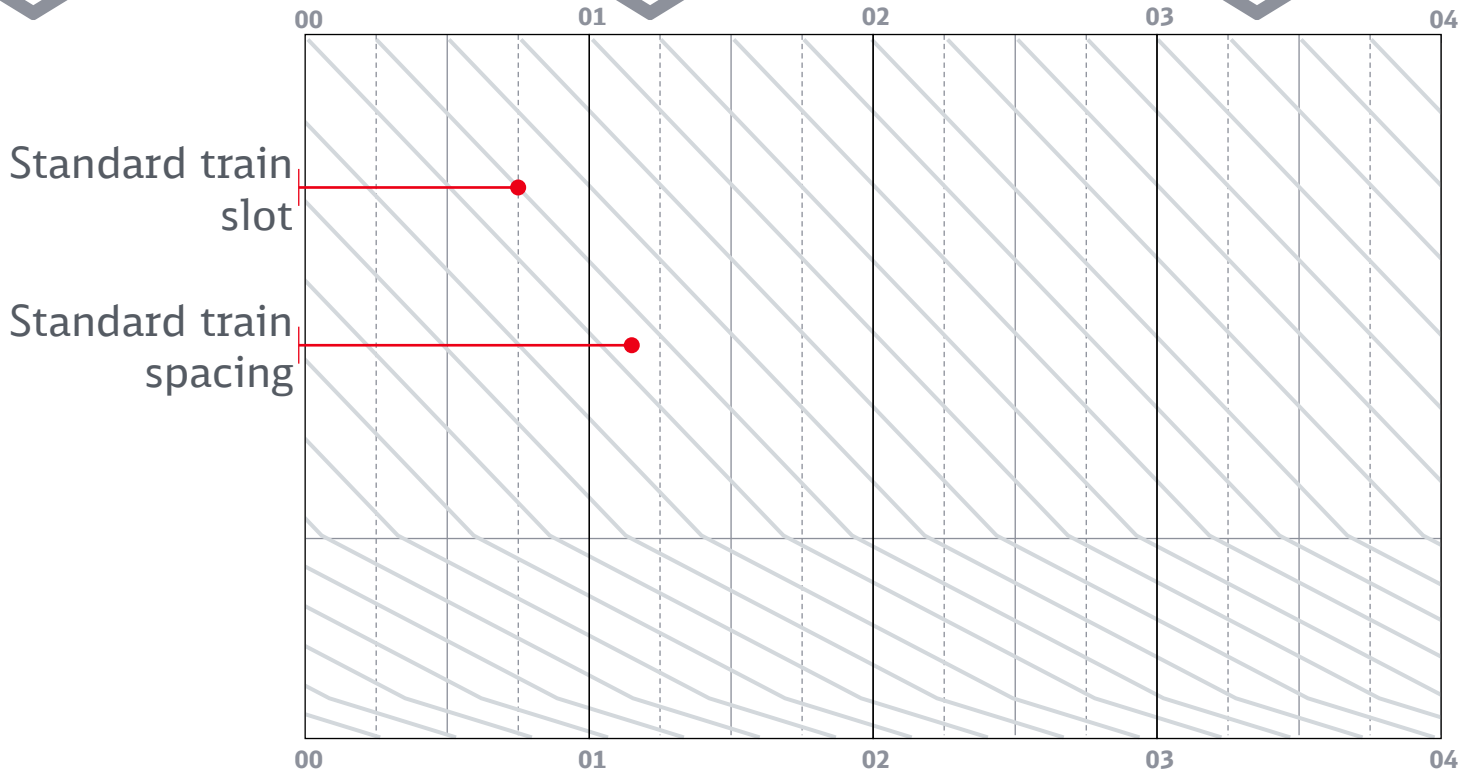
Like gridlines on paper, the train paths visualize capacity supply to assess utilization and frame benefit and trade-off discussions

Signal performance

Mainline capabilities

Mainline-yard interfaces



Supply

Train paths per day

Track capacity	**100%**
MoW allowance	
Passenger traffic	
Operating variability	
Available freight paths	

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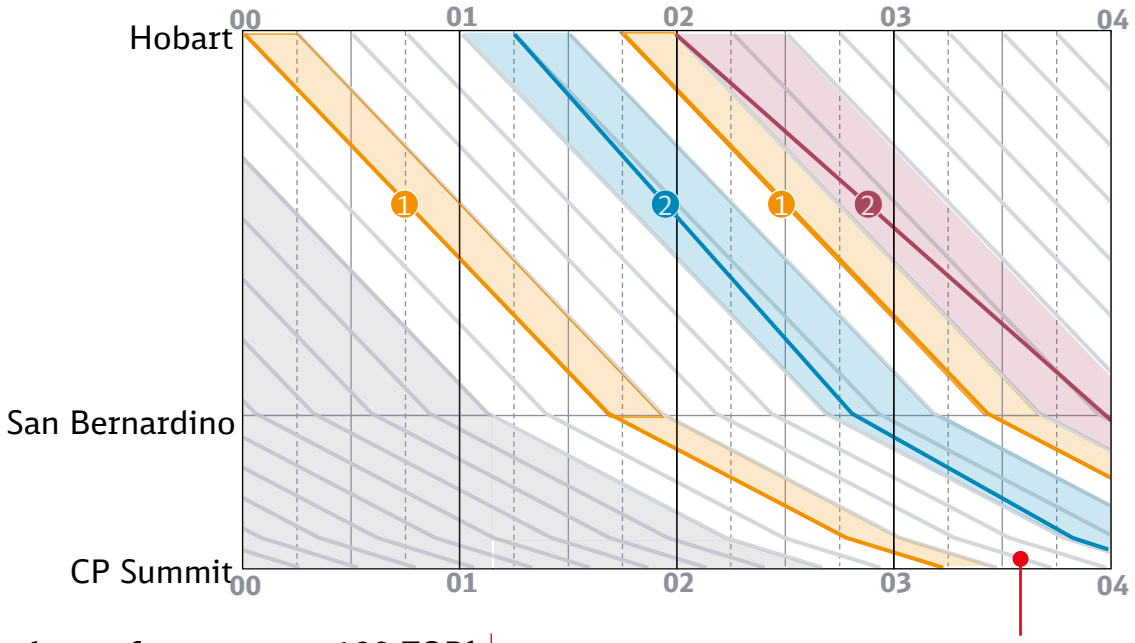
The method enables management to compare operating data against the capacity metric and understand capacity utilization

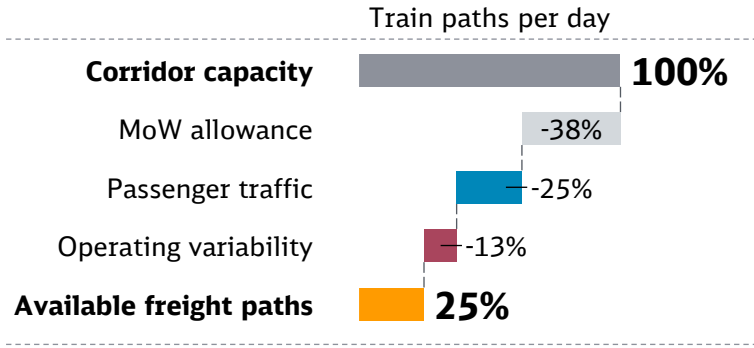
❶ Train paths consumed



Brake performance: 100 TOB[1]
Power: 3 HPT[2]
Speed: 50 mph
Length: 8500 ft

Headway: 15 minutes

Capacity utilization



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The framework assesses which projects, in which order would support the desired levels of service on the San Bernardino Subdivision

Illustrative

Comprehensive service, operations & infrastructure plans

Prioritized project list

Phase 1
- Signaling and interlocking improvement Part 1
- Station 1
- Yard staging improvements

Phase 2
- Station 2
- Signaling and interlocking improvement Part 2
- Yard upgrade Part 1
- Yard Connection track

Phase 3
- Yard west second lead track
- Yard East second lead track
- Construct 3rd track to Eastern limit

Phase 4
- Yard upgrade Part 2
- Intermodal yard
- Yard and mainline realignment
- 4th Main track

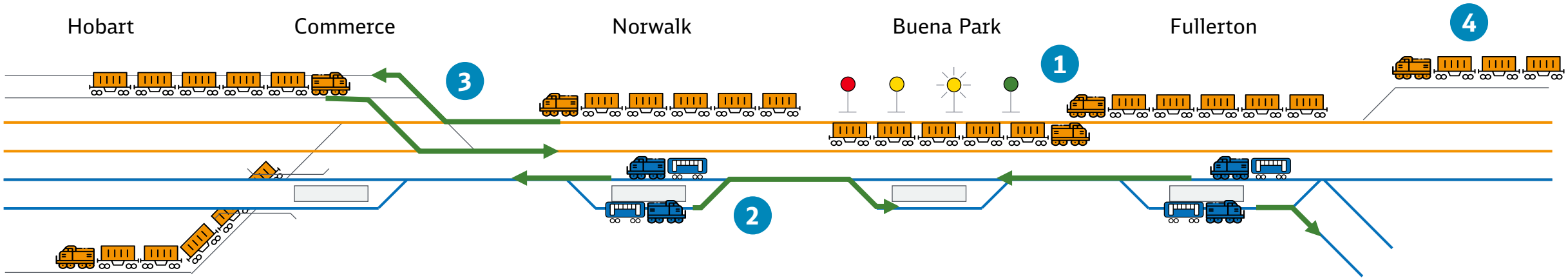
Service delivered

- Hourly passenger slot
  35 Freight slots
- 30 min passenger slot
  51 Freight slots
- 30 min passenger slot with peak overlay
  65 Freight slots
- 15 min passenger slot
  71 Freight slots

Results

BNSF can support freight traffic growth to 2040 (pre-HSR) by targeting four families of capacity enhancing projects

1. *Signal upgrades represent the most effective method to increase mainline throughput: a 5-minute headway reduction raises mainline capacity by 50%*
2. *Terminal and mainline interface upgrades at Hobart and Commerce facilities enable trains to land and be processed without blocking the mainline*
3. *Traffic flow separation through targeted mainline improvements at stations and passenger service harmonization*
4. *Freight trains stage at Lenwood when awaiting entry windows into the terminals at Hobart and Commerce*



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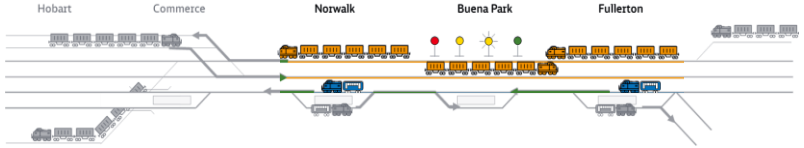
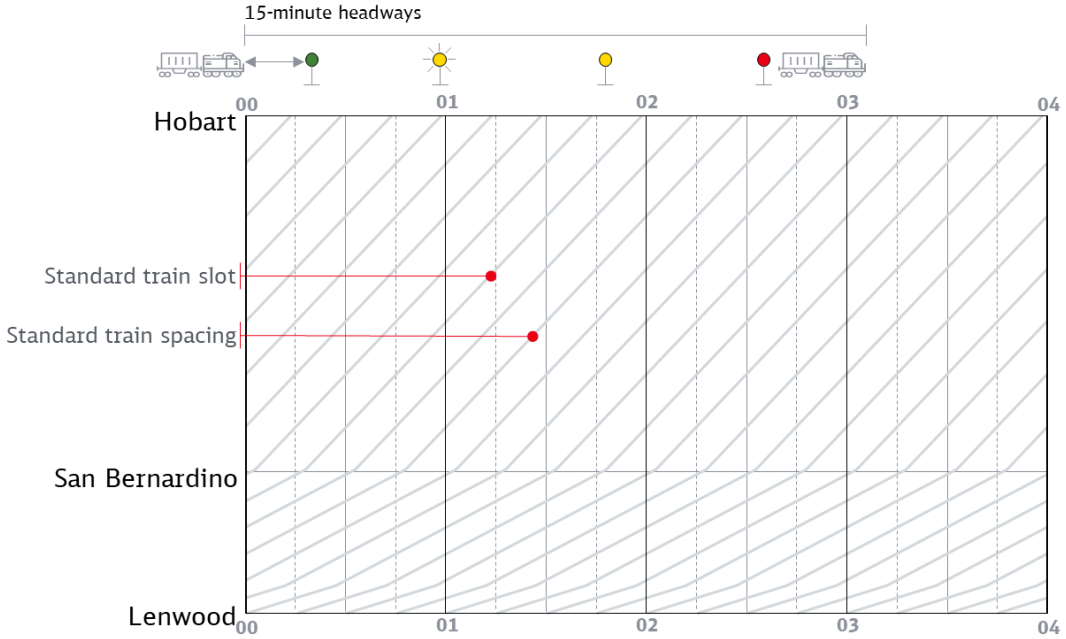
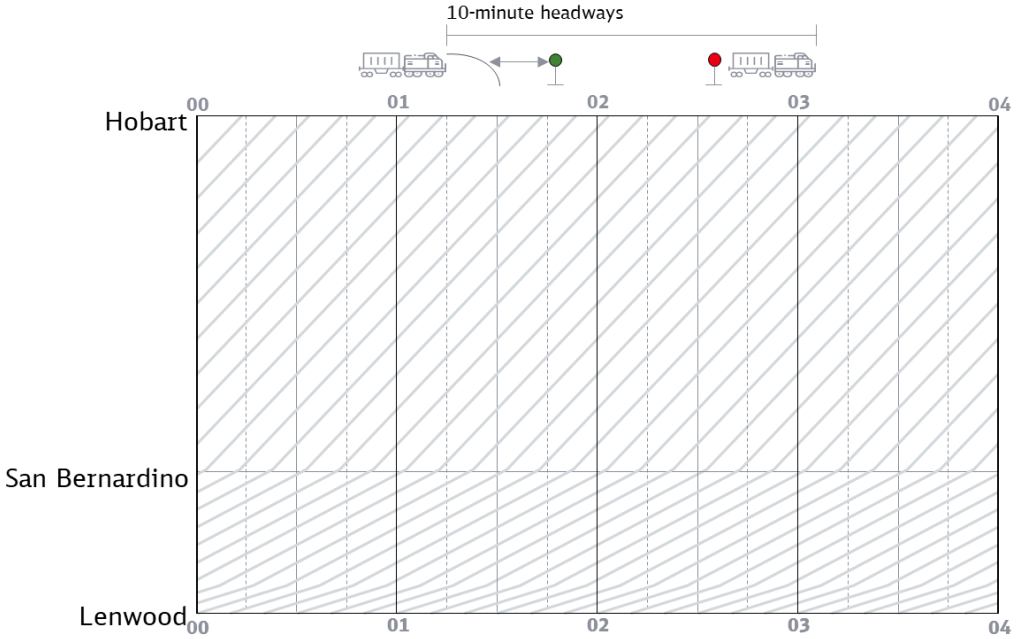
Signal upgrades represent the most effective method to increase mainline throughput: a 5-minute headway reduction raises mainline capacity by 50%



Current signaling capabilities support 4 Trains paths per hour per track[1]



Proposed signal upgrades could support 6 Trains paths per hour per track[1] [2]



(1) Measured for trains travelling in a uniform direction on a mainline track (2) Potential signalling solutions have been identified by the BNSF
Source: Dick, C., et al. 2019.

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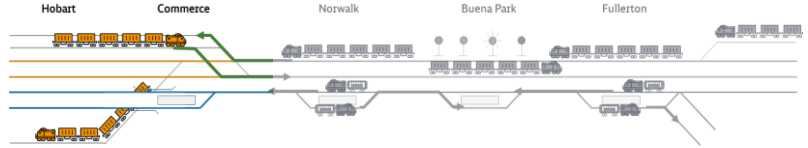
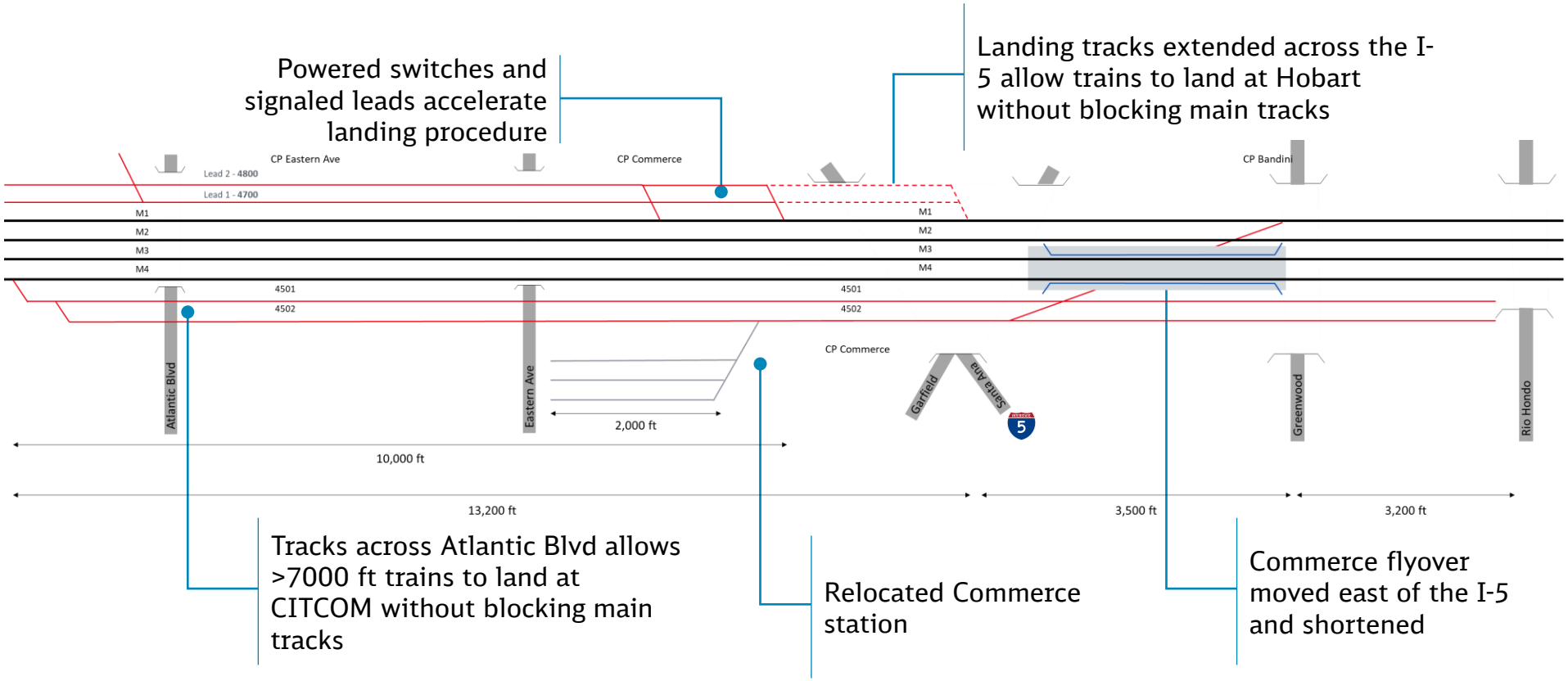
Terminal and mainline interface upgrades at Hobart and Commerce facilities enable trains to land and be processed without blocking the mainline



Illustrative schematic of upgraded Hobart & CITCOM facilities



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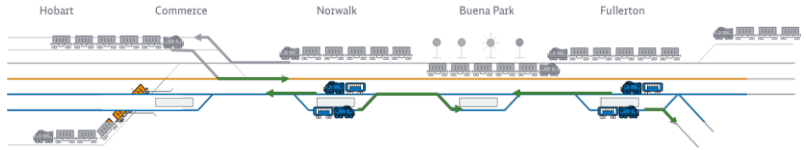
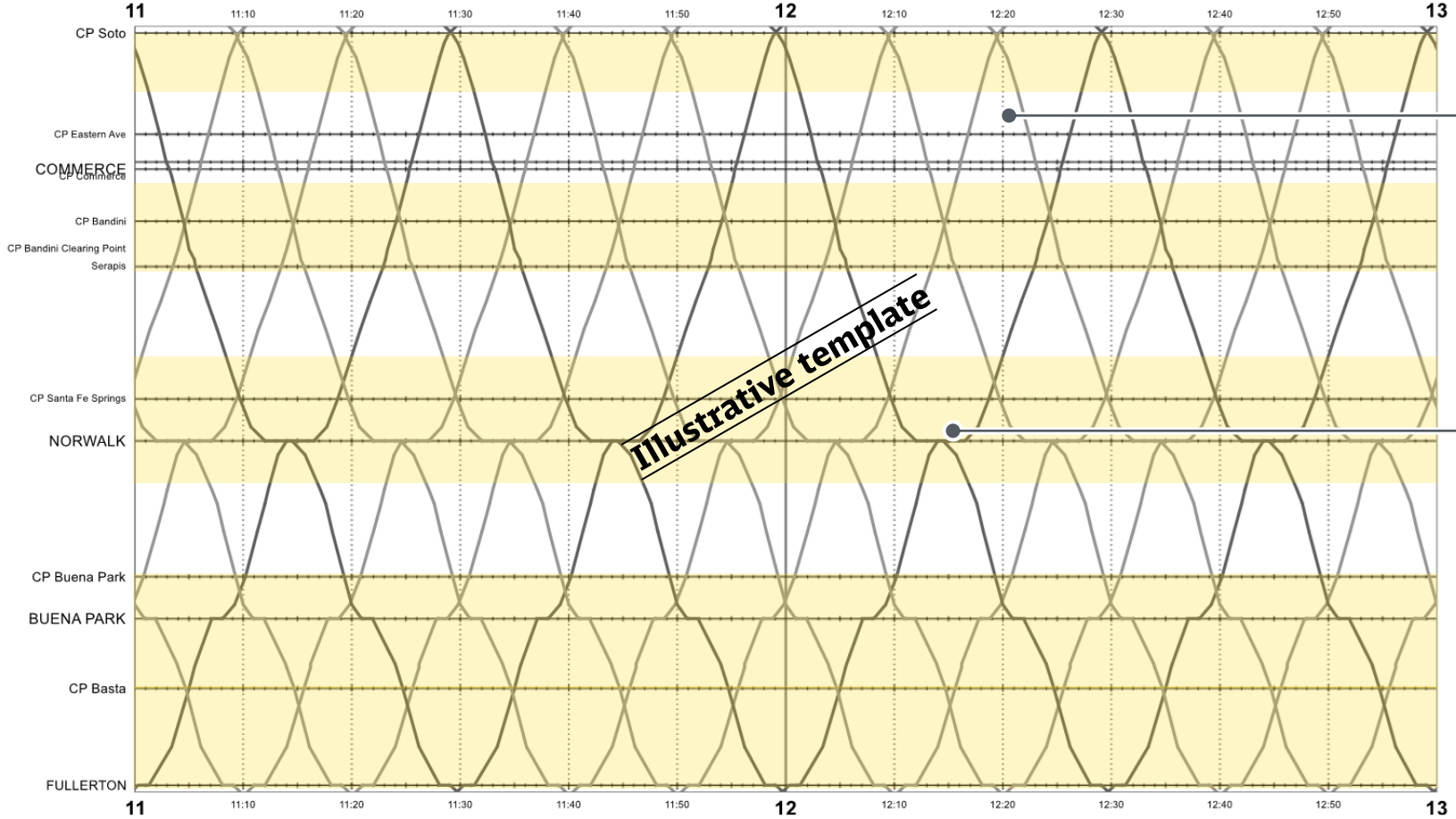
Traffic flow separation requires targeted mainline improvements at stations and passenger service harmonization





Trains operate on M3 only between station locations

Trains are timed to meet opposing traffic movements at stations with siding locations

Only a subset of train slots will be operable in the production schedule to ensure performance stability

4th track

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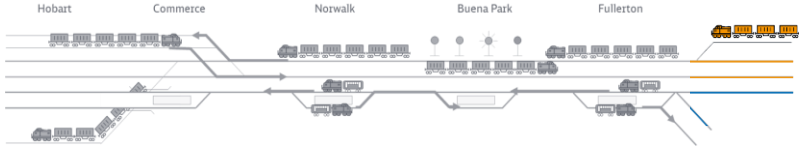
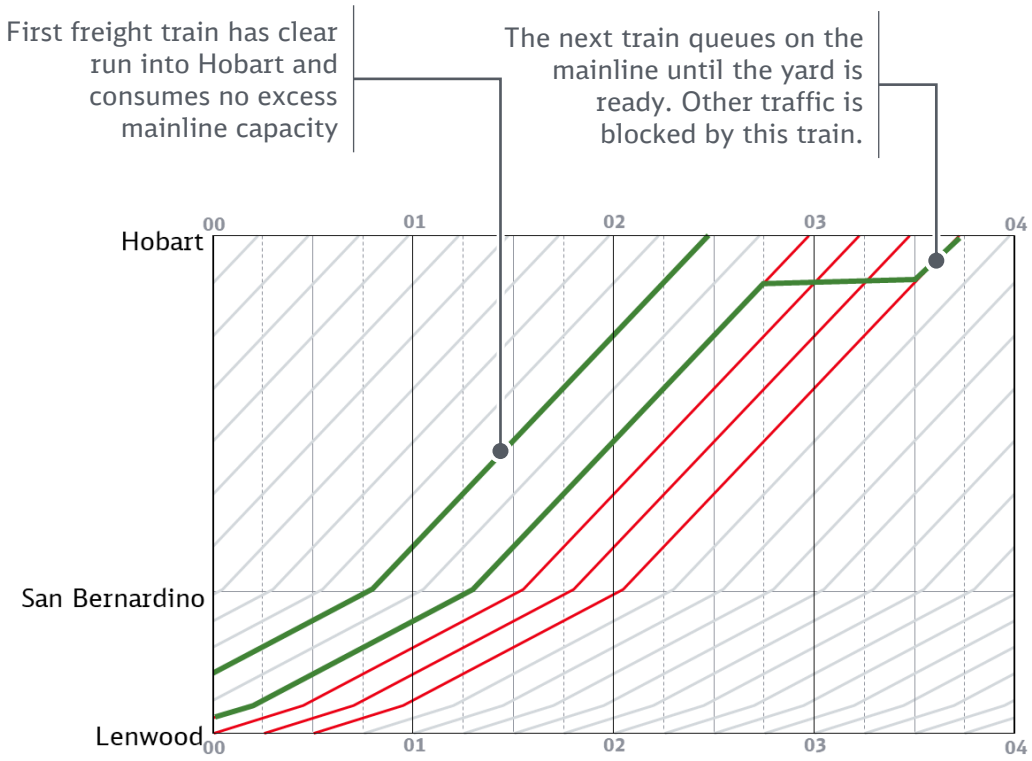
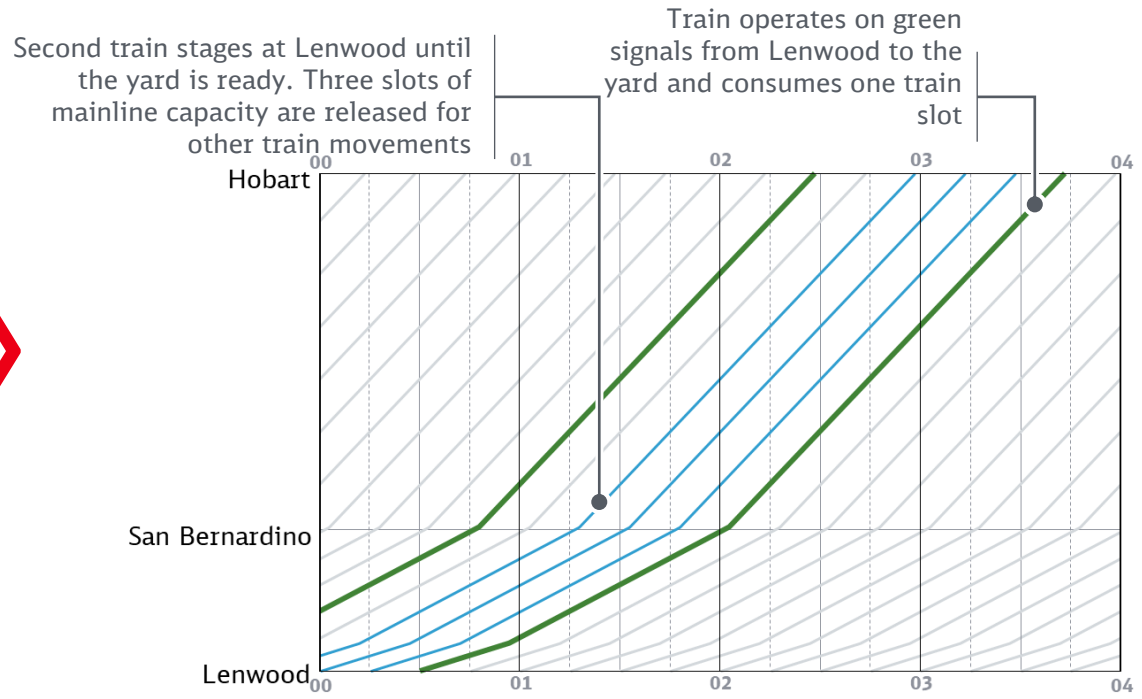
Staging trains at Lenwood when awaiting entry windows into the terminals at Hobart and Commerce releases 15 slots to the mainline (7 trains)



Current corridor conditions



In 2019, queuing trains consumed 15% of available mainline capacity

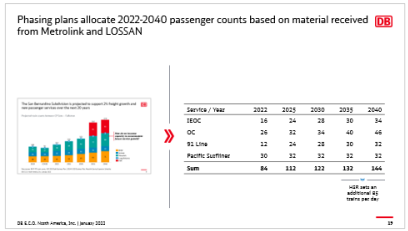


Staging trains at Lenwood reduces the risk of excess train queues in critical corridor segments

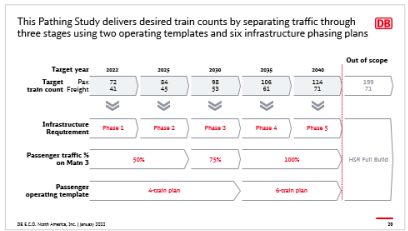
Used slot | Blocked slots | Occupied slot | Slot released to the mainline

Recommended phasing plans

The recommended phasing plans are linked to desired 2022-2040 passenger counts while ensuring freight traffic movement and growth are protected

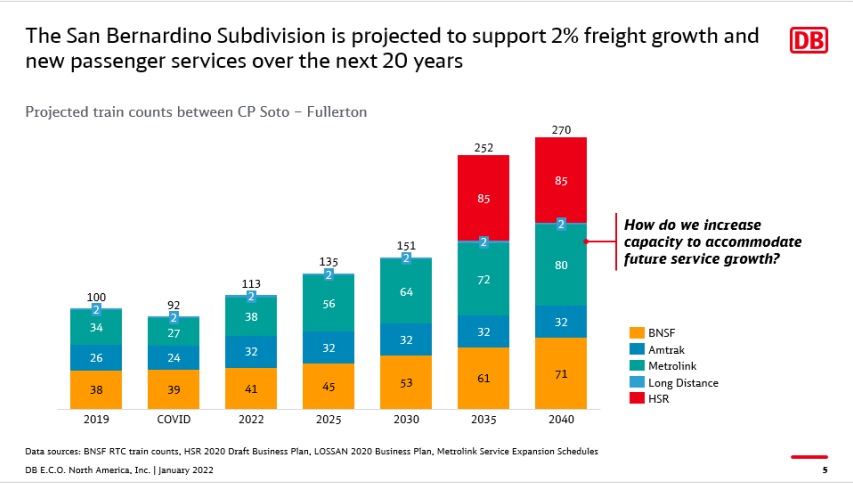


Train counts establish service needs



And determine operating and infrastructure requirements

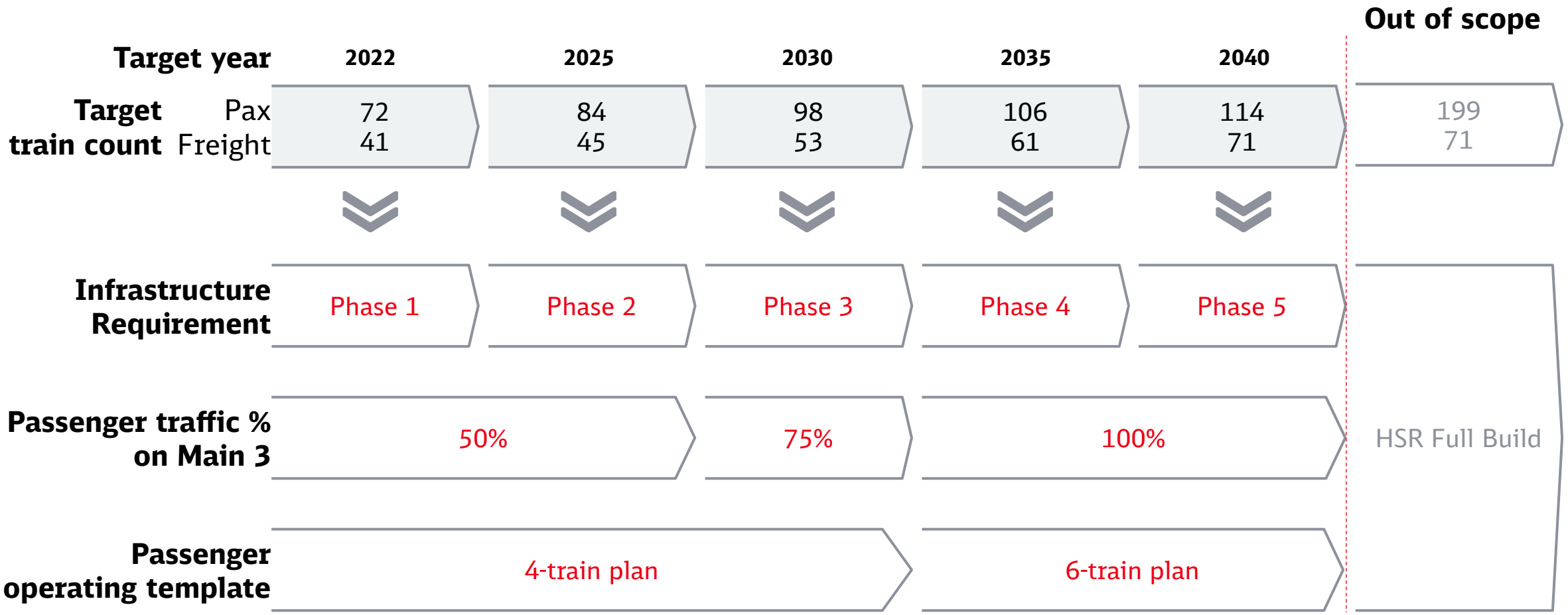
Phasing plans allocate 2022-2040 passenger counts based on material received from Metrolink and LOSSAN



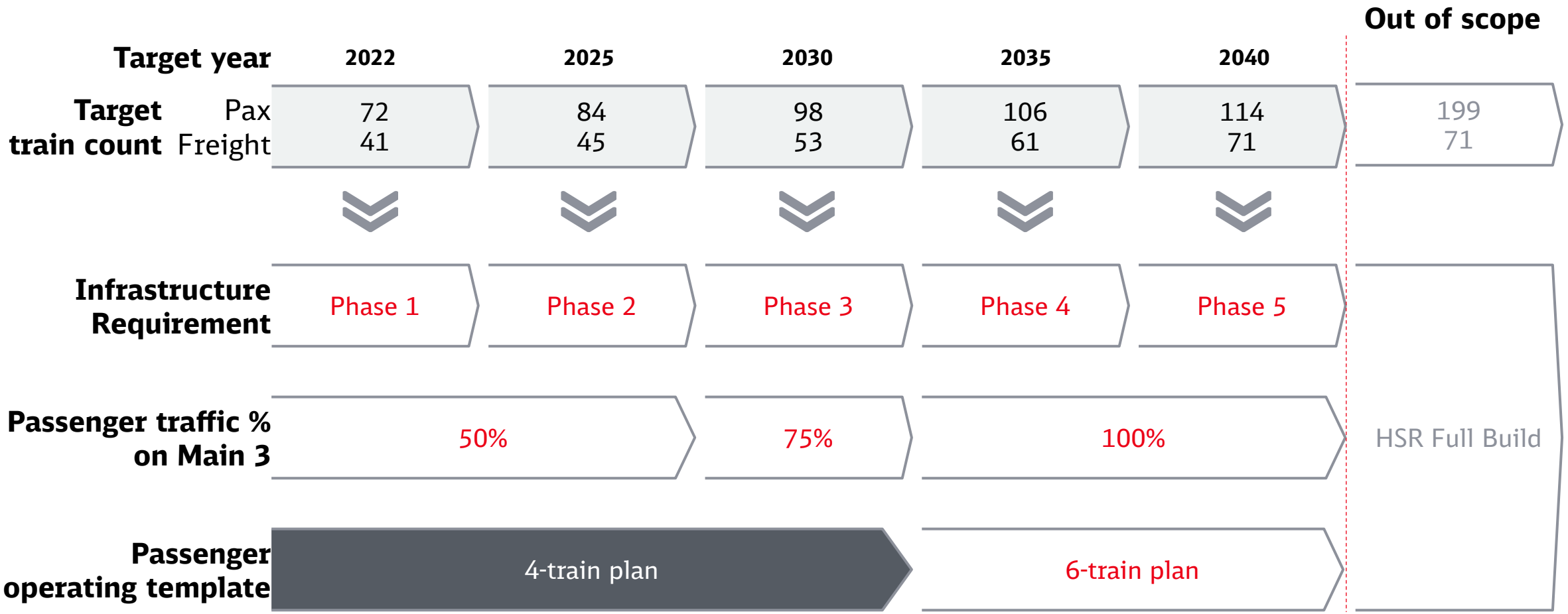
Service / Year	2022	2025	2030	2035	2040
IEOC	16	24	28	30	34
OC	26	32	34	40	46
91 Line	12	24	28	30	32
Pacific Surfliner	30	32	32	32	32
Sum	**84**	**112**	**122**	**132**	**144**

HSR sets an additional 85 trains per day

This Pathing Study delivers desired train counts by separating traffic through three stages using two operating templates and six infrastructure phasing plans

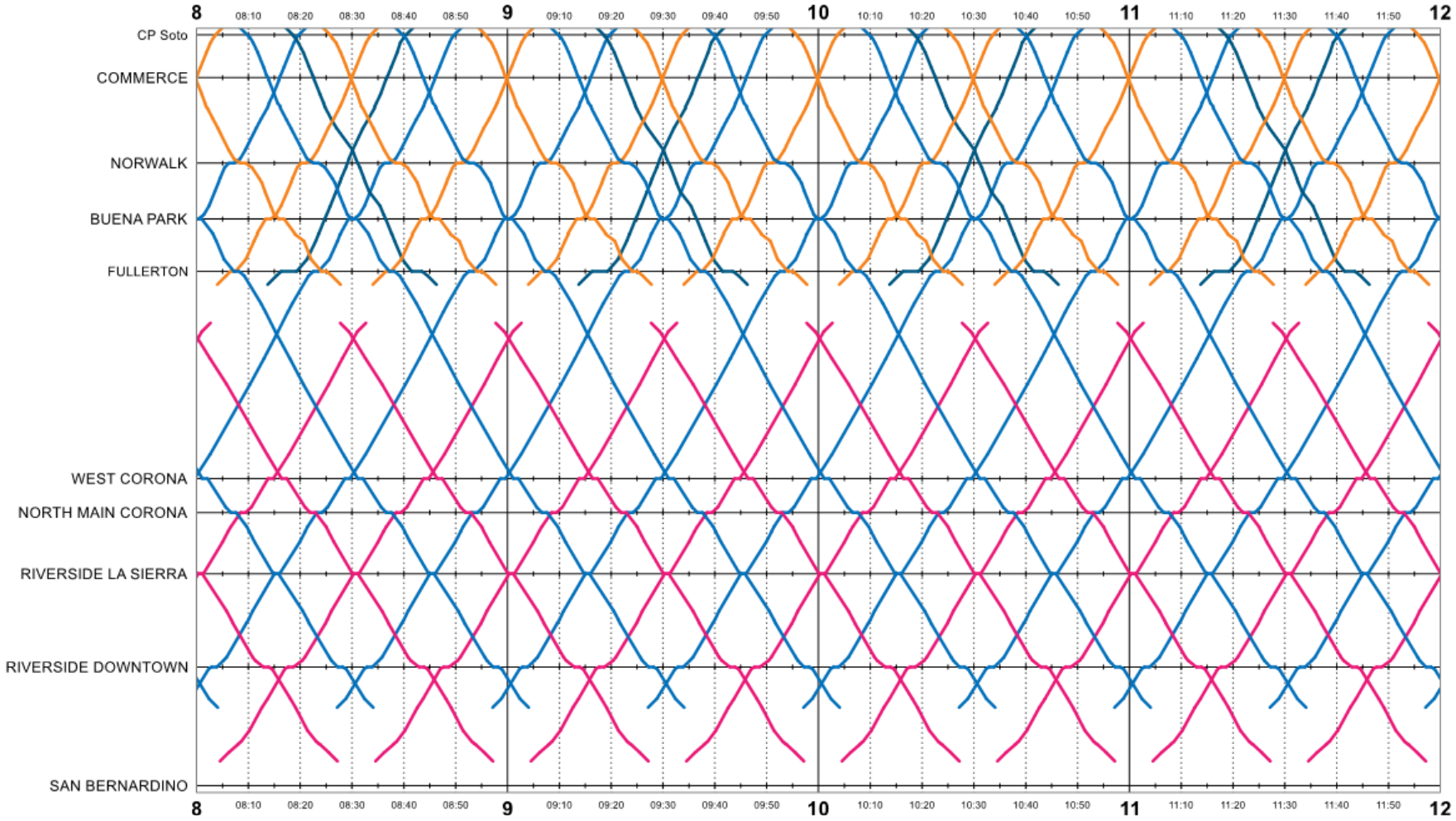


The 4-train passenger plan supports 2022-30 train counts through infrastructure phases 1-3 to separate traffic from 50% to 75%[1]



(1) % passenger traffic operating on Main 3 (and sidings that will eventually become Main 4)

This 4-train plan template represents a catalogue of train slots that operators can select to inform the design of an operating plan.



Track assignment

Phase 1 infrastructure
Westbound
- Metrolink on Main 1
- Pacific Surfliner on Main 2

Eastbound
- Metrolink Main 3
- Pacific Surfliner on Main 3

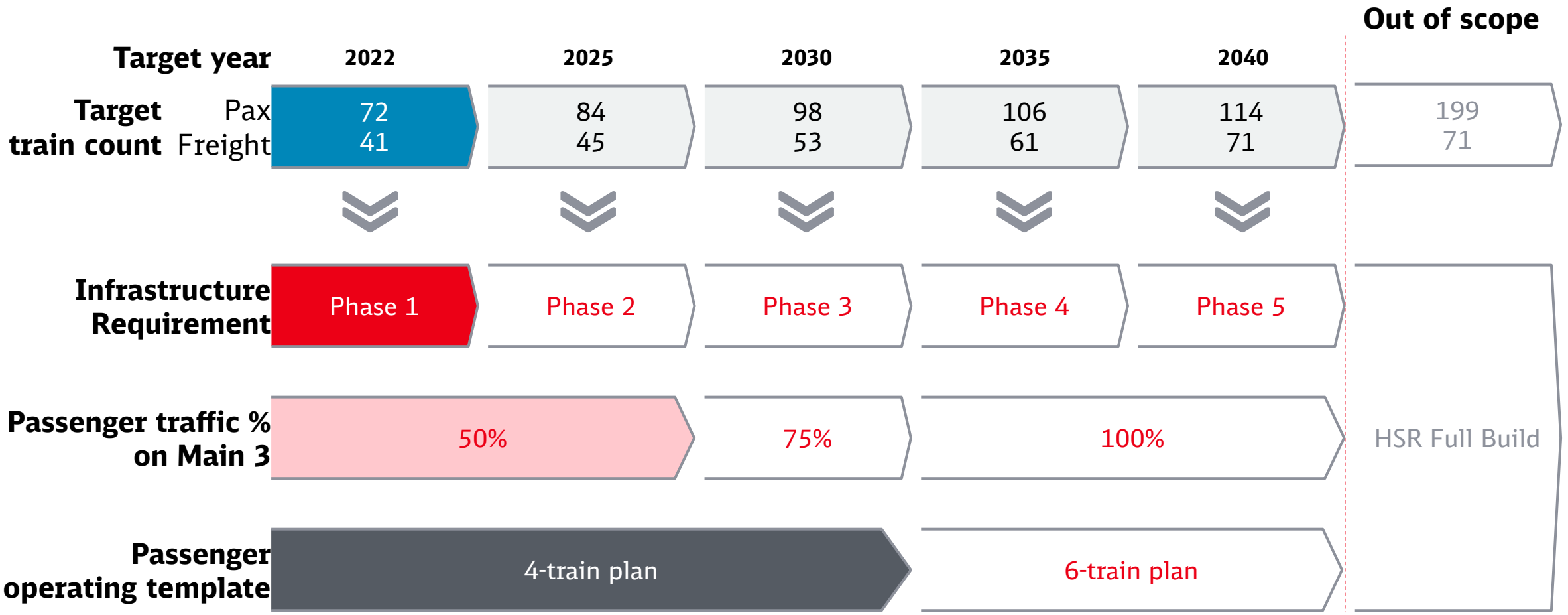
Phase 2 infrastructure
Westbound
- Metrolink on Main 1
- Pacific Surfliner on Main 2

Eastbound
- Metrolink Main 3
- Pacific Surfliner on Main 3

Phase 3 infrastructure
Westbound
- Metrolink on Main 3
- Pacific Surfliner on Main 1

Eastbound
- Metrolink Main 3
- Pacific Surfliner on Main 2

To achieve 2022 train counts, Phase 1 infrastructure upgrades are required for 50% traffic separation[1] using the 4-train plan passenger operating structure



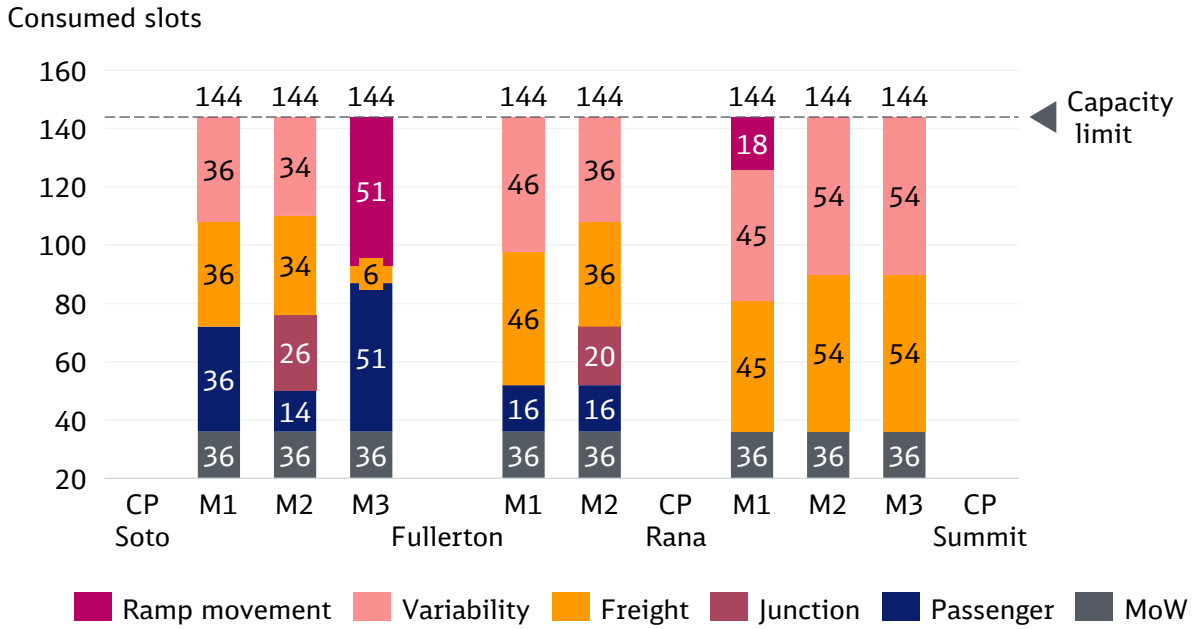
(1) % passenger traffic operating on Main 3 (and sidings that will eventually become Main 4)

Phase 1 upgrades focus on improving the corridor's signaling system and on critical mainline-yard interfaces at CITCOM and Hobart

Train service output

Westbound:		Eastbound:	
IEOC	8 trains	IEOC	8 trains
OC	13 trains	OC	12 trains
91 Line	6 trains	91 Line	7 trains
Pacific Surfliner	15 trains	Pacific Surfliner	15 trains

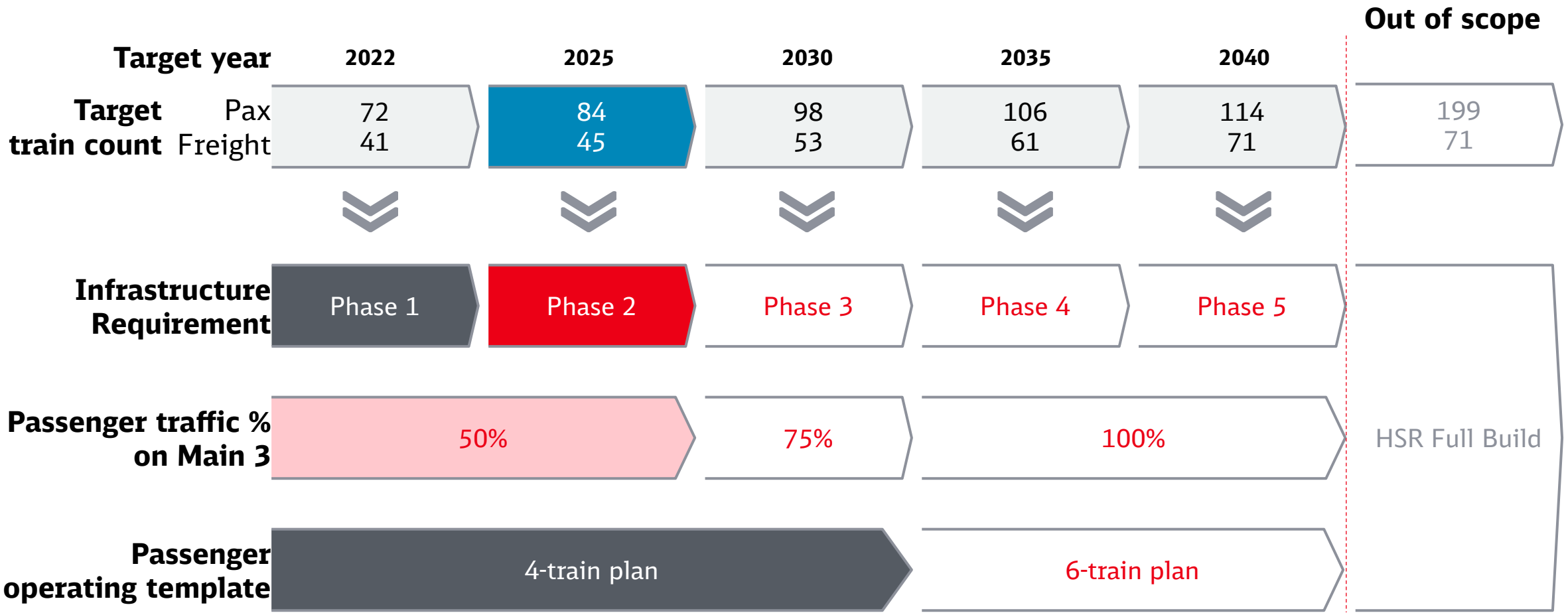
Operating environment



Infrastructure projects

Project Name	Location (MP)	Initiative	Project Description	Project benefit
Commerce Station relocation	MP 148.3-148.7	Separating passenger and freight services	Relocate Commerce station from MP 148.3 to its new location (TBC) subject to engineering feedback on its feasibility of phasing. The station could remain decommissioned until the Commerce flyover is complete	Enables CITCOM to be remodeled with extended tracks. Enables future passenger and freight traffic separation
Hobart First Lead track	MP 147.3-149.8	Clearing mainline	Extend the Eastern Ave lead to 15,000 ft over the I-5 to CP Bandini. The bridge over the I-5 needs to be widened to support CITCOM tracks, Hobart leads and three mainlines.	Release mainline capacity through improvement of the freight landing procedure
CITCOM support tracks	MP 146.5-149.5	Unlocking facilities	Extend CITCOM support tracks to East Hobart and Bandini	15,000 ft support tracks enable freight trains to be processed without the need to occupy mainline tracks. CITCOM switching will become more efficient due to longer switching leads (~5,000 ft).
10-minute headway signal upgrade	Entire San Bernardino Subdivision	Clearing mainline	Upgrade the corridor's signal system to support 10-minute headways	Trains not exceeding 8,500 ft, 100 TOB can run at 10-minute headways

To achieve 2025 train counts, phase 1-2 infrastructure upgrades are required for 50% traffic separation[1] using a 4-train plan passenger operating structure



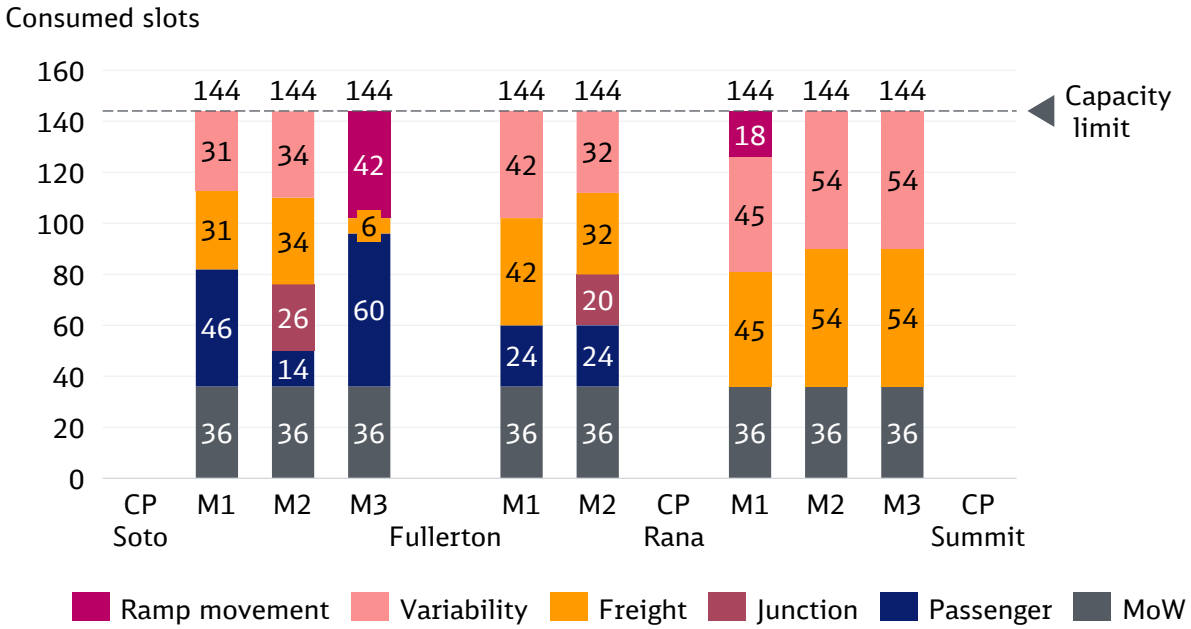
(1) % passenger traffic operating on Main 3 (and sidings that will eventually become Main 4)

Phase 2 upgrades target freight terminal leads and staging enhancements to support traffic separation with a passenger option to add Placentia Station.

Train service output

Westbound:		Eastbound:	
IEOC	12 trains	IEOC	12 trains
OC	16 trains	OC	17 trains
91 Line	12 trains	91 Line	11 trains
Pacific Surfliner	16 trains	Pacific Surfliner	16 trains

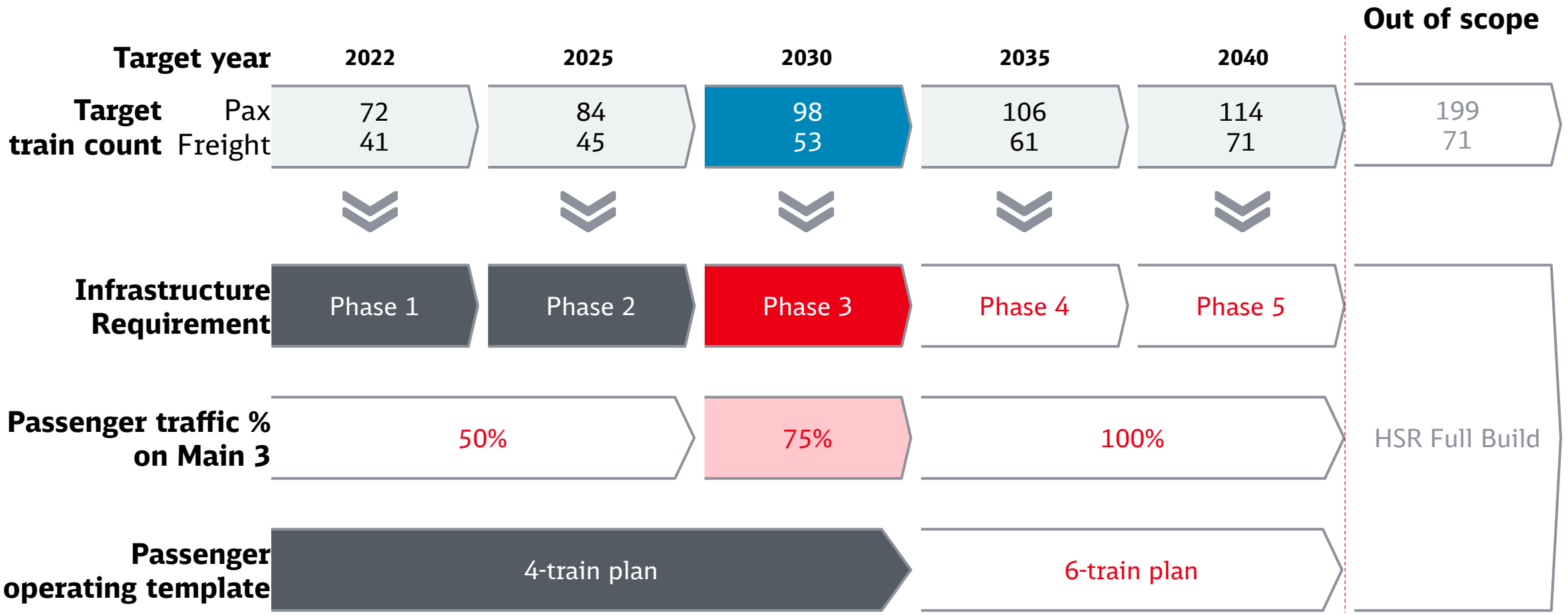
Operating environment



Infrastructure projects

Project Name	Location (MP)	Initiative	Project Description	Project benefit
Commerce station siding	MP 149.2-150.2	Separating passenger and freight services	3,500 ft station siding does not require additional bridge space on I-5 or Rio Hondo river and could be located between them. The siding is long enough to allow passenger trains to pass at speed. The siding should have No.20 turnouts and signals.	Commerce station siding is part of the effort to provide meet locations for passenger trains to separate freight and passenger flows.
Hobart Second Lead track	MP 147.3-149.8	Clearing mainline	Extend the Industry lead to 15,000 ft over the I-5 to CP Bandini . The bridge over the I-5 needs to be widened to support both Hobart leads.	Release mainline capacity through improvement of the freight landing procedure. Due to frequency of traffic, Hobart needs to be able to arrive/depart two trains at a time. Two leads will prevent queueing on the mainlines amd
La Mirada Lead Extension	MP 157.2-158.4	Unlocking facilities	La Mirada lead extension from Valley View Ave to Carmenita	Provide track connection for the freight local movements to access clients directly from La Mirada facility without the need to foul mainlines.
Lenwood Staging	BNSF Cajon Sub	Clearing mainline	Staging facility with four tracks close to Barstow	Provide entry windows for the freight trains into the terminals at Hobart, Commerce and ACTA
Placentia Station Platform	MP 43	Separating passenger and freight services	Additional station for Metrolink 91 services	Increased passenger coverage for Metrolink 91 services

To achieve 2030 train counts, phase 1-3 infrastructure upgrades are required for 75% traffic separation[1] using a 4-train plan passenger operating structure



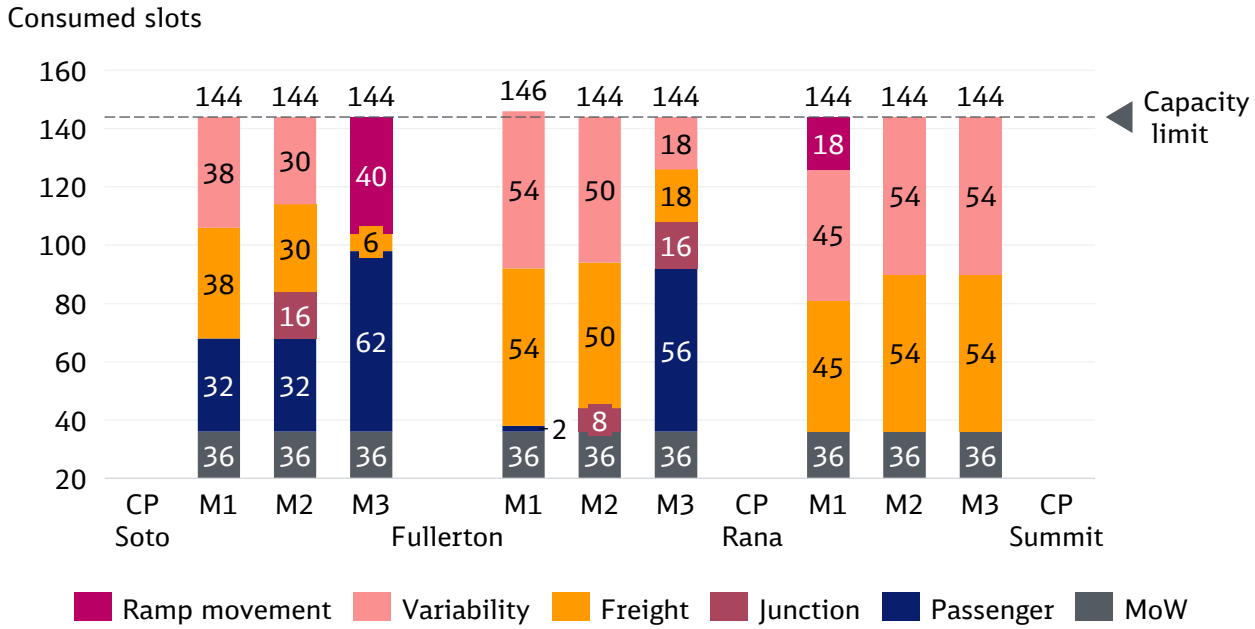
(1) % passenger traffic operating on Main 3 (and sidings that will eventually become Main 4)

Phase 3 upgrades target station enhancements to enable increased passenger operations on Main 3 and targeted siding locations (that will become Main 4)

Train service output

Westbound:		Eastbound:	
IEOC	14 trains	IEOC	14 trains
OC	17 trains	OC	18 trains
91 Line	14 trains	91 Line	13 trains
Pacific Surfliner	16 trains	Pacific Surfliner	16 trains

Operating environment



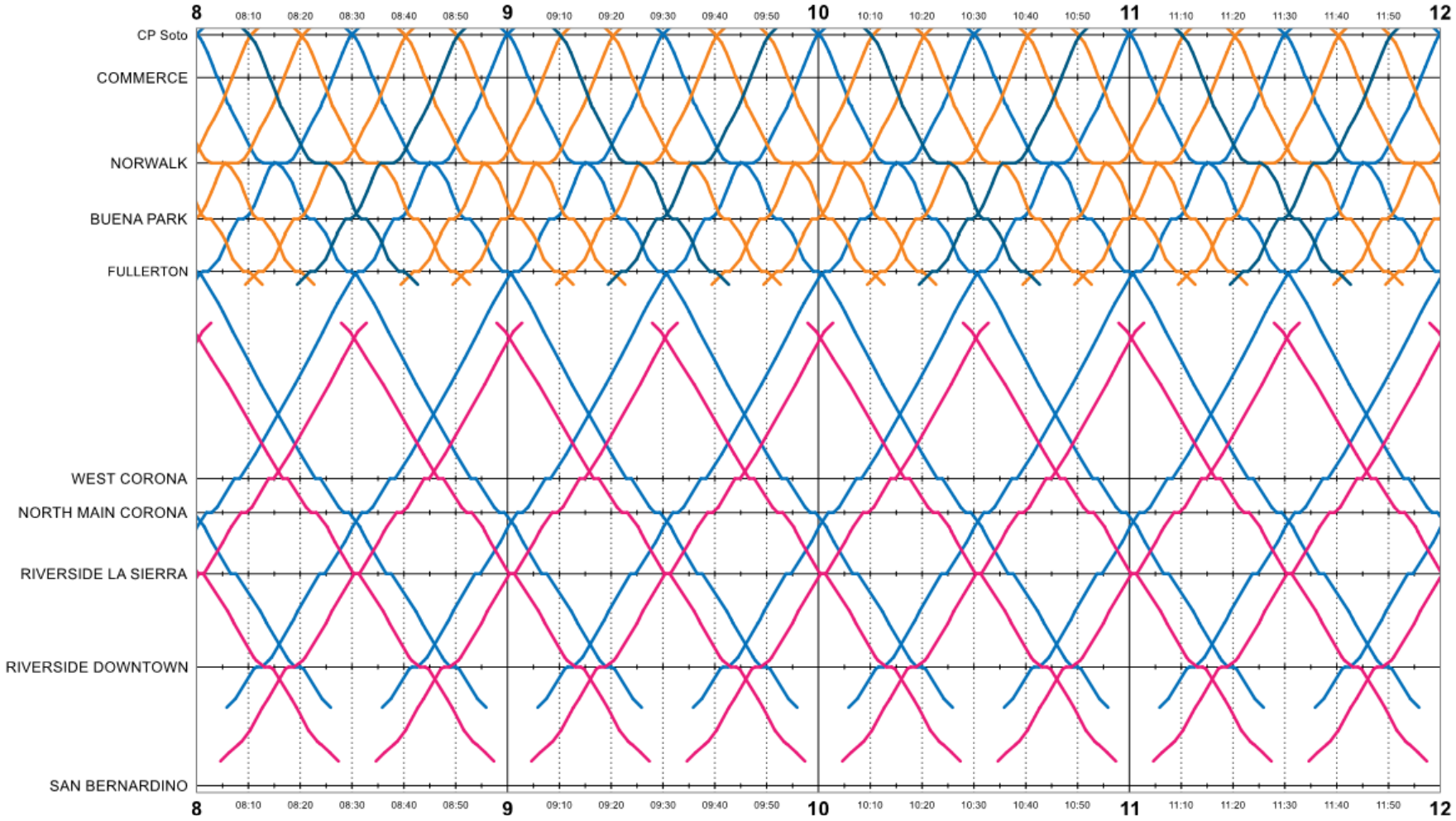
Infrastructure projects

Project Name	Location (MP)	Initiative	Project Description	Project benefit
Buena Park Station Siding	MP 159.7-161.7	Separating passenger and freight services	5000 ft sidings at the stations east and west of Fullerton	Provide passenger meet opportunities and raise capacity supply on M3 from 96 to 192 slots per day
Fullerton Station Siding	MP 164.6-165.6			
West Corona Station Siding	MP 26.4-27.4			
Riverside La Sierra Station Siding	MP 18-19			
MP 33 Siding	MP 32.5-33.5	Separating passenger and freight services	5000 ft at Esperanza and Riverside	Provide passenger meet opportunities and raise capacity supply on M3 from 96 to 192 slots per day
MP 12 Siding	MP 12-13			
Buena Park, Fullerton, West Corona and Riverside platforms	--	Separating passenger and freight services	Decommission platform on M1	Discourage passenger flow to M1 and M2
Fullerton to Esperanza third track	MP 165.5-35.8	Separating passenger and freight services	Fullerton to Riverside Downtown investments (SCORE)	Provide passenger only third track between Fullerton and Riverside Downtown
Prado to Colton third track	MP 29.4-10.6	Separating passenger and freight services		
Esperanza siding	MP 30-35	Clearing mainline	Repurpose existing Esperanza to M1 track and recreate Esperanza north of M1 track	Provide additional staging opportunity between Lenwood and ACTA
Colton IMF leads	MP 3.2-6.1	Unlocking facilities	Double leads into Colton IMF for eastbound and westbound freight traffic.	

The 6-train passenger plan supports 2035-40 train counts through infrastructure phases 4-5 with 100% traffic separation[1]

(1) % passenger traffic operating on Main 3 (and sidings that will eventually become Main 4)

This 6-train plan template represents a catalogue of trains slots that operators can select to inform the design of an operating plan.

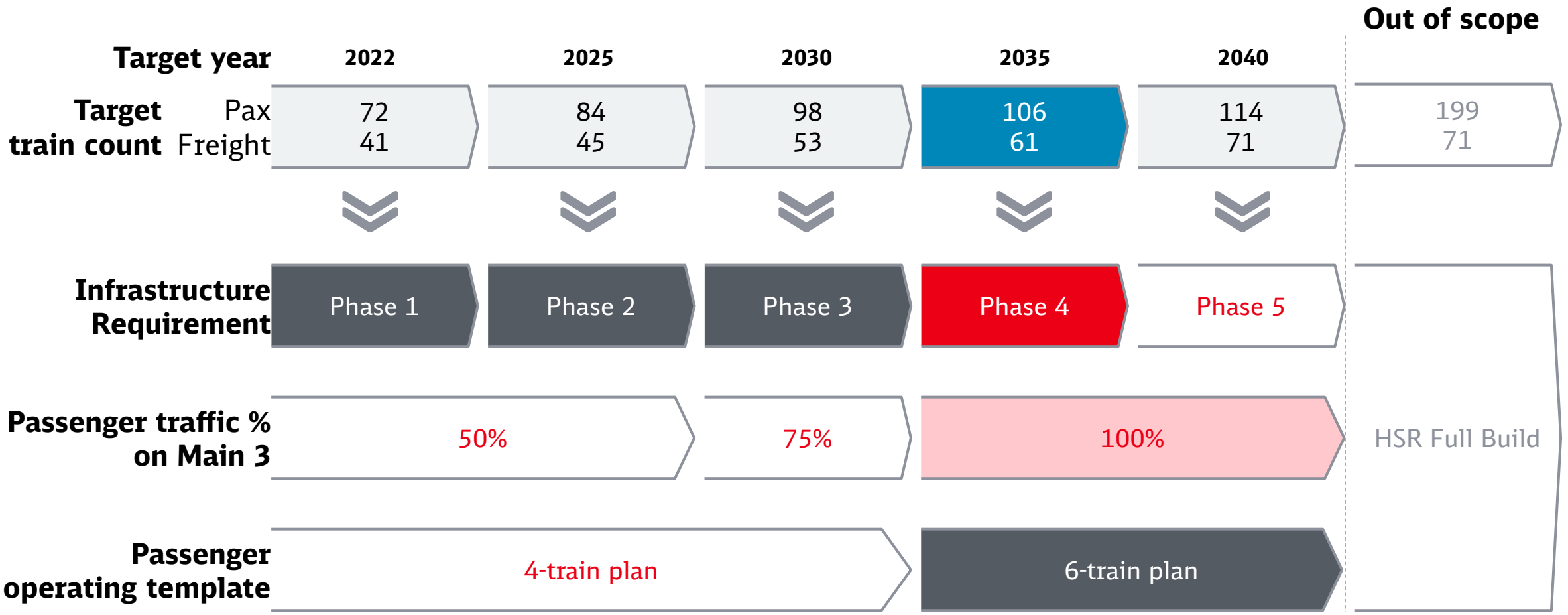


Track assignment

Phase 4 infrastructure
Passenger operates on Main 3 all day
Freight operates on Main 1 and 2

Phase 5 infrastructure
Passenger operates on Main 3 all day
Freight operates on Main 1 and 2

To achieve 2035 train counts, phase 1-4 infrastructure upgrades are required for 100% traffic separation[1] using a 6-train plan passenger operating structure



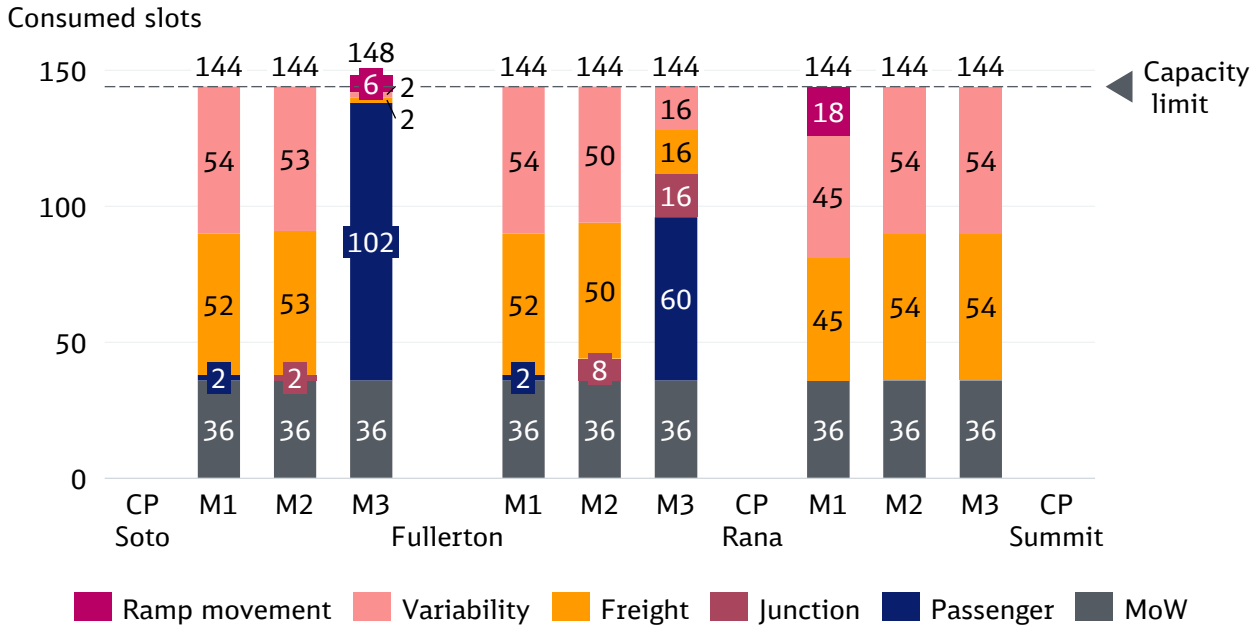
(1) % passenger traffic operating on Main 3 (and sidings that will eventually become Main 4)

Phase 4 extends sections of fourth track to support higher train frequencies on Main 3 and Main 4

Train service output

Westbound:		Eastbound:	
IEOC	15 trains	IEOC	15 trains
OC	20 trains	OC	20 trains
91 Line	15 trains	91 Line	15 trains
Pacific Surfliner	16 trains	Pacific Surfliner	16 trains

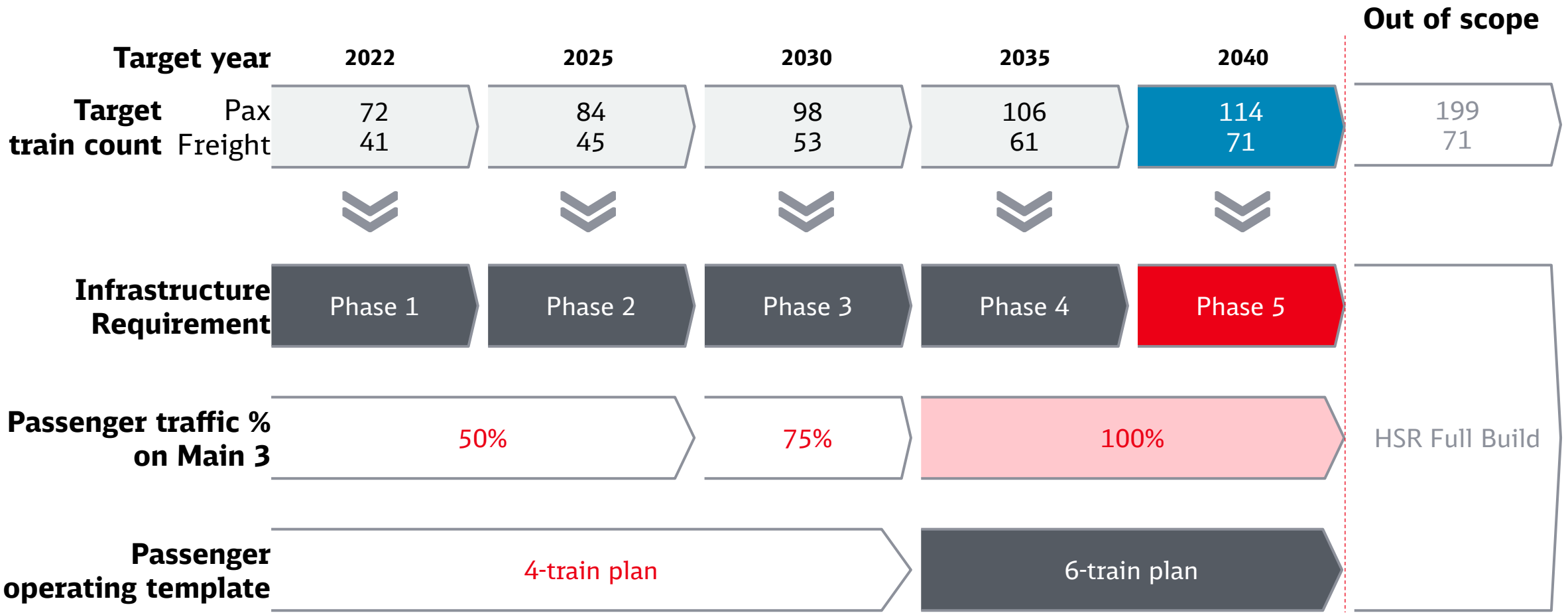
Operating environment



Infrastructure projects

Project Name	Location (MP)	Initiative	Project Description	Project benefit
Fullerton to Coyote 4th track connection	MP 160.7-165.5	Separating passenger and freight services	4th track connection between Buena Park station siding and Fullerton station siding	Provide passenger meet opportunities and raise capacity supply on M3 from 144 to 288 slots per day
Norwalk siding extension	MP 155-156.1	Separating passenger and freight services	4th track from Telegraph Rd to CP West Norwalk	Provide passenger meet opportunities and raise capacity supply on M3 from 144 to 288 slots per day
CITCOM flyover	MP 149.2-150.2	Unlocking facilities	Passenger train flyover between I-5 and Rio Hondo river bridge	Provide freight train access into the CITCOM facility without fouling passenger flows on M3

To achieve 2040 train counts, phase 1-5 infrastructure upgrades are required for 100% traffic separation[1] using a 6-train plan passenger operating structure



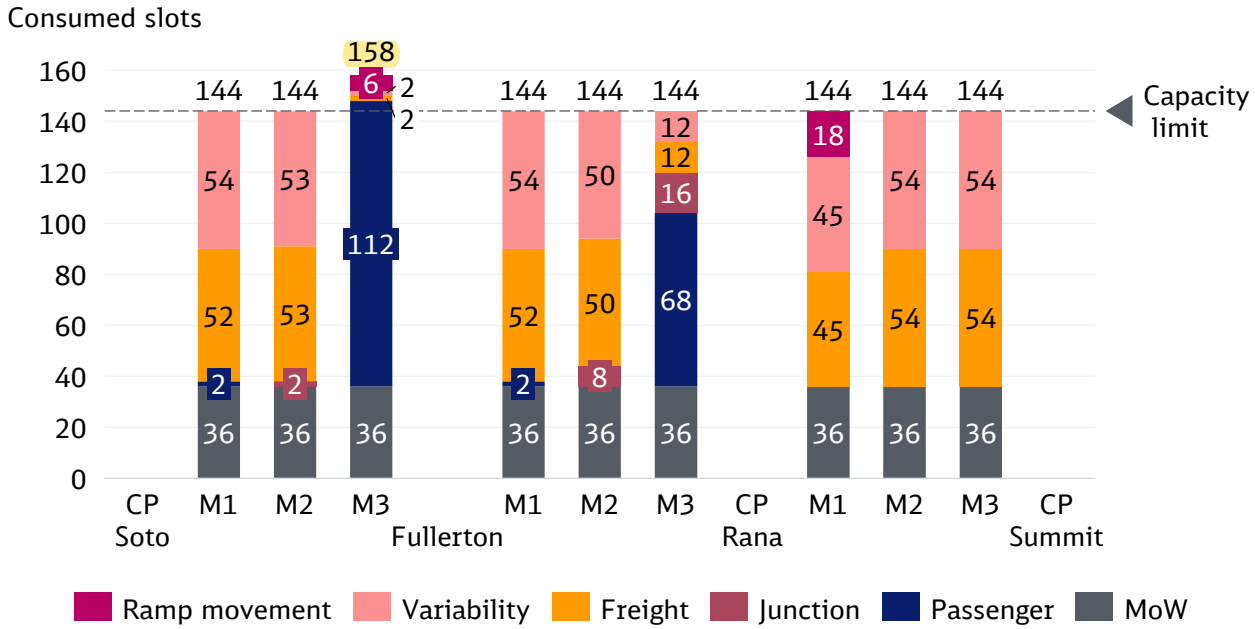
(1) % passenger traffic operating on Main 3 (and sidings that will eventually become Main 4)

Phase 5 extends sections of fourth track to support higher train frequencies on Main 3 and Main 4

Train service output

Westbound:		Eastbound:	
IEOC	15 trains	IEOC	15 trains
OC	20 trains	OC	20 trains
91 Line	15 trains	91 Line	15 trains
Pacific Surfliner	16 trains	Pacific Surfliner	16 trains

Operating environment



Infrastructure projects

Project Name	Location (MP)	Initiative	Project Description	Project benefit
MP34 to La Sierra 4th track	MP 34-18	Separating passenger and freight services	4th track connection between West Corona and La Sierra stations	Provide passenger meet opportunities and raise capacity supply on M3 from 144 to 288 slots per day
Riverside Siding Extension	MP 12-10.3	Separating passenger and freight services	4th track connection between MP 12 and Riverside Downtown station	Provide passenger meet opportunities and raise capacity supply on M3 from 144 to 288 slots per day

Appendix

1. Capital project list
2. Capacity components
3. Illustrative Stringline charts
4. Infrastructure phasing schematics

Infrastructure project list (1/2)

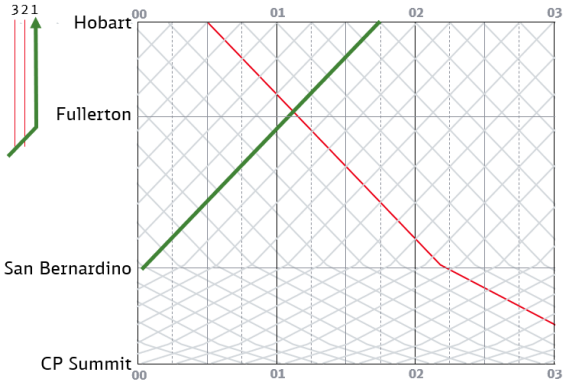
Stage,	Passenger operating template	Train Count year	Project Name	Location (MP)	Initiative	Project Description	Project benefit
1	4-Train Plan	2022	Commerce Station relocation	MP 148.3-148.7	Separating passenger and freight services	Relocate Commerce station from MP 148.3 to its new location (TBC) subject to engineering feedback on its feasibility of phasing. The station could remain decommissioned until the Commerce flyover is complete	Enables CITCOM to be remodelled with extended tracks. Enables passenger and freight traffic separation
			Hobart First Lead track	MP 147.3-149.8	Clearing mainline	Extend the Eastern Ave lead to 15,000 ft over the I-5 to CP Bandini. The bridge over the I-5 needs to be widened to support CITCOM tracks, Hobart leads and three mainlines.	Release mainline capacity through improvement of the freight landing procedure
			CITCOM support tracks	MP 146.5-149.5	Unlocking facilities	Extend CITCOM support tracks to East Hobart and Bandini	15,000 ft support tracks enable freight trains to be processed without the need to occupy mainline tracks. CITCOM switching will become more efficient due to longer switching leads (~5,000 ft).
			10-minute headway signal upgrade	Entire San Bernardino Subdivision	Clearing mainline	Upgrade the corridor's existing existing system to support 10-minute headways	Trains not exceeding 8,500 ft, 100 TOB can run at 10-minute headways
2	4-Train Plan	2025	Commerce station siding	MP 149.2-150.2	Separating passenger and freight services	3,500 ft station siding does not require additional bridge space on I-5 or Rio Hondo river and needs to be located between them. The siding is long enough to allow passenger trains to pass at speed. The siding needs to have No.20 turnouts and signals.	Commerce station siding is a part of the effort to provide meet locations for passenger trains to separate freight and passenger flows.
			Hobart Second Lead track	MP 147.3-149.8	Clearing mainline	Extend the Industry lead to 15,000 ft over the I-5 to CP Bandini . The bridge over the I-5 needs to be widened to support both Hobart leads.	Release mainline capacity through improvement of the freight landing procedure. Due to frequency of traffic, Hobart needs to be able to arrive/depart two trains at a time. Two leads will prevent queueing on the mainlines amd
			La Mirada Lead Extension	MP 157.2-158.4	Unlocking facilities	La Mirada lead extension from Valley View Ave to Carmenita	Provide track connection for the freight local movements to access clients directly from La Mirada facility without the need to foul mainlines.
			Lenwood Staging	BNSF Cajon Sub	Clearing mainline	Staging facility with four tracks close to Barstow	Provide entry windows for the freight trains into the terminals at Hobart, Commerce and ACTA
			Placentia Station Platform	MP 43	Separating passenger and freight services	Additional station for Metrolink 91 services	Increased passenger coverage for Metrolink 91 services

Infrastructure project list (2/2)

Phase	Passenger operating template	Train Count year	Project Name	Location (MP)	Initiative	Project Description	Project benefit
3	4-Train Plan	2030	Buena Park Station Siding	MP 159.7-161.7	Separating passenger and freight services	5000 ft sidings at the stations east and west of Fullerton	Separating passenger and freight services Provide passenger meet opportunities and raise capacity supply on M3 from 96 to 192 slots per day
			Fullerton Station Siding	MP 164.6-165.6			
			West Corona Station Siding	MP 26.4-27.4			
			Riverside La Sierra Station Siding	MP 18-19			
			MP 33 Siding	MP 32.5-33.5	Separating passenger and freight services	5000 ft at Esperanza and Riverside	Provide passenger meet opportunities and raise capacity supply on M3 from 96 to 192 slots per day
			MP 12 Siding	MP 12-13			
			Buena Park, Fullerton, West Corona and Riverside platforms	--	Separating passenger and freight services	Decommission platform on M1	Discourage passenger flow to M1 and M2
			Fullerton to Esperanza third track	MP 165.5-35.8	Separating passenger and freight services	Fullerton to Riverside Downtown investments (SCORE)	Provide passenger only third track between Fullerton and Riverside Downtown
			Prado to Colton third track	MP 29.4-10.6	Separating passenger and freight services		
			Esperanza siding	MP 30-35	Clearing mainline	Shift existing Esperanza staging track	Provide additional staging opportunity between Lenwood and ACTA
			Colton IMF leads	MP 3.2-6.1	Unlocking facilities	Double leads into Colton IMF for eastbound and westbound freight traffic.	
4	6-Train Plan	2035	Fullerton to Coyote 4th track connection	MP 160.7-165.5	Separating passenger and freight services	4th track connection between Buena Park station siding and Fullerton station siding	Provide passenger meet opportunities and raise capacity supply on M3 from 144 to 288 slots per day
			Norwalk siding extension	MP 155-156.1	Separating passenger and freight services	4th track from Telegraph Rd to CP West Norwalk	Provide passenger meet opportunities and raise capacity supply on M3 from 144 to 288 slots per day
			CITCOM flyover	MP 149.2-150.2	Unlocking facilities	Passenger train flyover between I-5 and Rio hondo river bridge	Provide freight train access into the CITCOM facility without fouling passenger flows on M3
5	6-Train Plan	2040	MP34 to La Sierra 4th track	MP 34-18	Separating passenger and freight services	4th track connection between West Corona and La Sierra stations	Provide passenger meet opportunities and raise capacity supply on M3 from 144 to 288 slots per day
			Riverside Siding Extension	MP 12-10.3	Separating passenger and freight services	4th track connection between MP 12 and Riverside Downtown station	Provide passenger meet opportunities and raise capacity supply on M3 from 144 to 288 slots per day

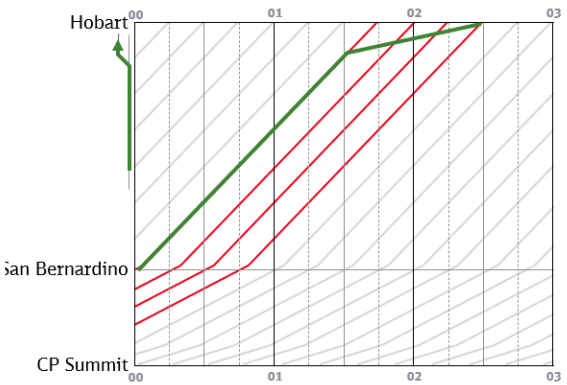
Explanation of capacity components

Junction



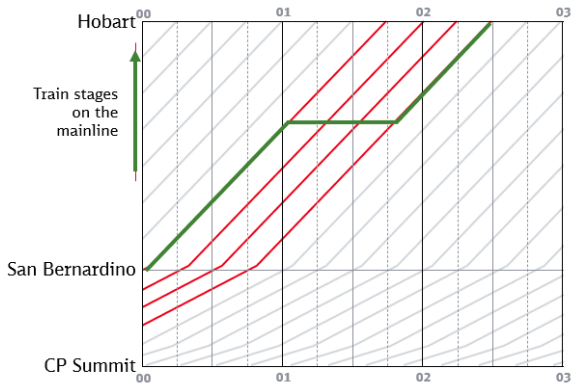
Train (green line) consumes 1 slot on Main 2 and Main 3 as it crosses over to Main 1

On-Ramp Movement



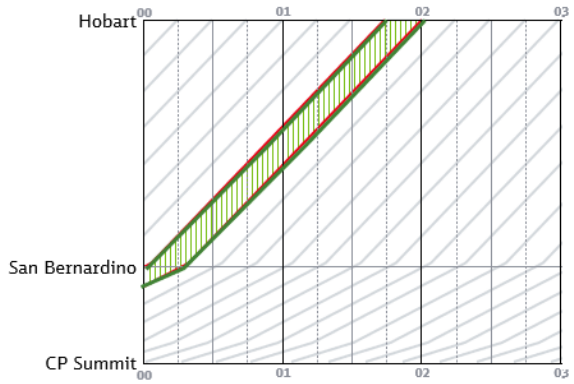
Train consumes 3 additional slots as it decelerates into the terminal

Staging



Train stages on the mainline and consumes 3 slots

Variability



Variability defines train runtime subject to random, operational interruptions

OS Data insights

Based on 2019 OS data, 15% of capacity is consumed by junction movements and track switches

Based on 2019 OS data, Freight consumes 1.4 slots on average for each movement in and out of the yards

Based on 2019 OS data, 15% of capacity is consumed by junction movements and track switches

Based on 2019 data, each freight train consumes on average 2 slots in total. Extra slots consumed embody the variability in freight operation.

Used slot Blocked slots Occupied slot

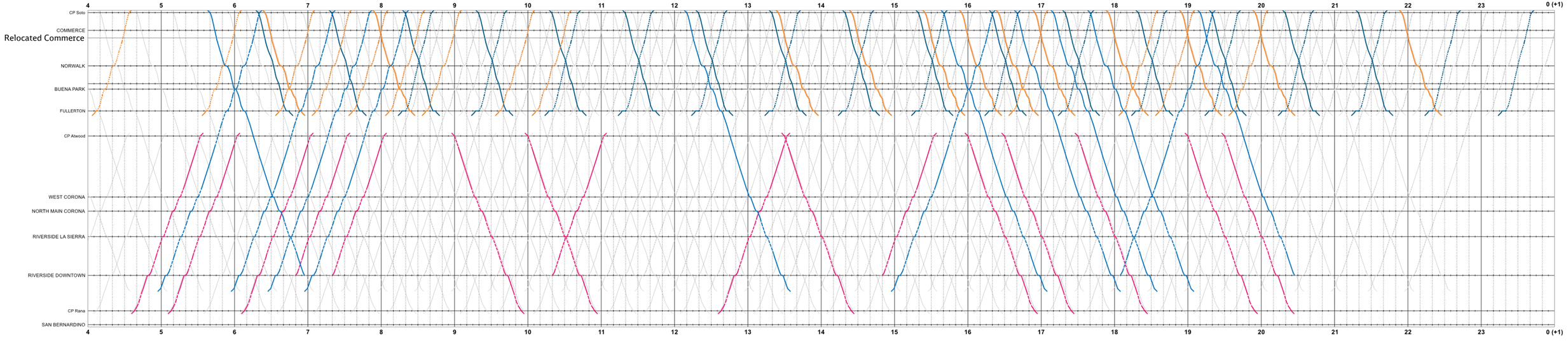
2022 Metrolink Schedule – San Bernardino Subdivision

4-Train Plan on Phase 1 infrastructure, 50% separation - Westbound passenger traffic on the M1 and M2 freight tracks

Westbound traffic operates on M1,M2 between Soto and Fullerton
Eastbound traffic operates on M3 between Soto and Fullerton

Westbound traffic operates on M1 between Fullerton and San Bern
Eastbound traffic operates on M2 between Fullerton and San Bern

Illustrative



Service Type — Pacific Surfliner — Orange County — IEOC — 91 — Dedicated passenger track on M3 — Passenger services operating on freight tracks — Train Slot template

Disclaimer: These stringlines are based on prior Metrolink proposals rebased on to the passenger service templates. They were developed solely to inform capacity consumption calculations and should not be interpreted as final operating schedules.

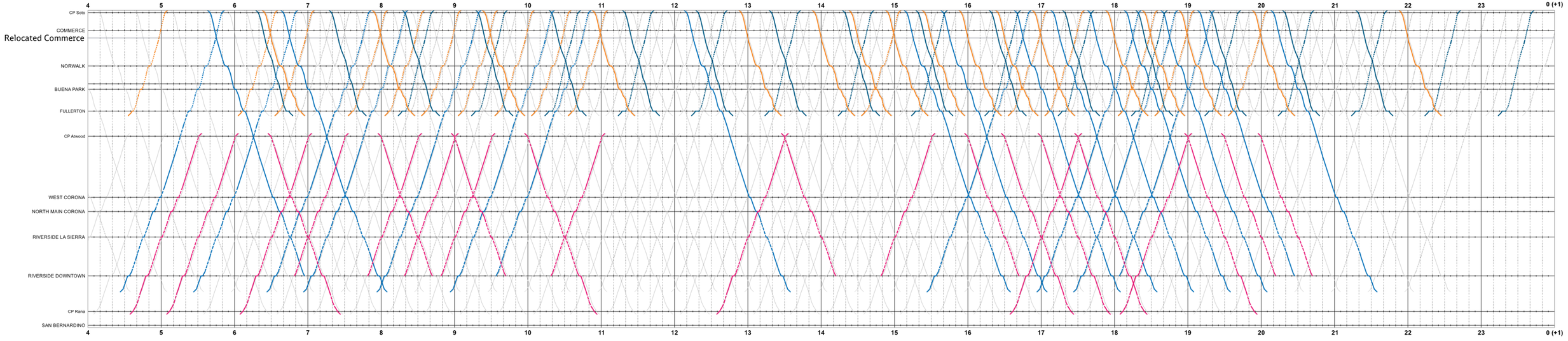
2025 Metrolink Schedule – San Bernardino Subdivision

4-Train Plan on Phase 2 infrastructure, 50% separation - Westbound passenger traffic on the freight tracks

Westbound traffic operates on M1,M2 between Soto and Fullerton
Eastbound traffic operates on M3 between Soto and Fullerton

Westbound Metrolink operates on M1 between Fullerton and San Bern
Eastbound Metrolink operates on M2 between Fullerton and San Bern

Illustrative



Service Type — Pacific Surfliner — Orange County — IEOC — 91 — Dedicated passenger track — Passenger services operating on freight tracks — Train Slot template

Disclaimer: These stringlines are based on prior Metrolink proposals rebased on to the passenger service templates. They were developed solely to inform capacity consumption calculations and should not be interpreted as final operating schedules.

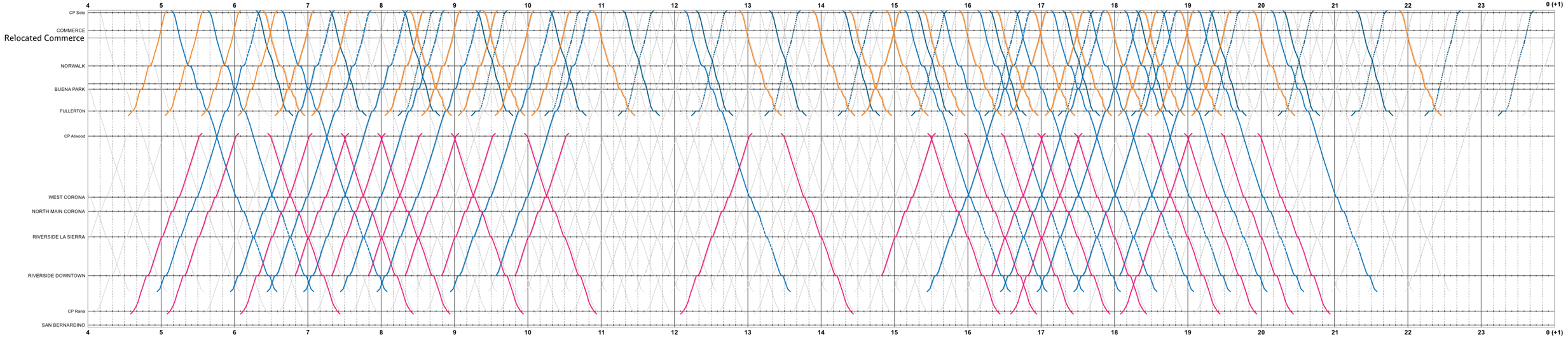
2030 Metrolink Schedule – San Bernardino Subdivision

4-Train Plan on Phase 3 infrastructure, 75% separation – Amtrak traffic on the freight tracks

Surfliner operates on M1 and M2 between Soto and Fullerton
Metrolink operates on M3 between Soto and Fullerton

Westbound Metrolink operates on M1 between Fullerton and San Bern
Eastbound Metrolink operates on M2 between Fullerton and San Bern

Illustrative



Service Type — Pacific Surfliner — Orange County — IEOC — 91 — Dedicated passenger track — Passenger services operating on freight tracks — Train Slot template

Disclaimer: These stringlines are based on prior Metrolink proposals rebased on to the passenger service templates. They were developed solely to inform capacity consumption calculations and should not be interpreted as final operating schedules.

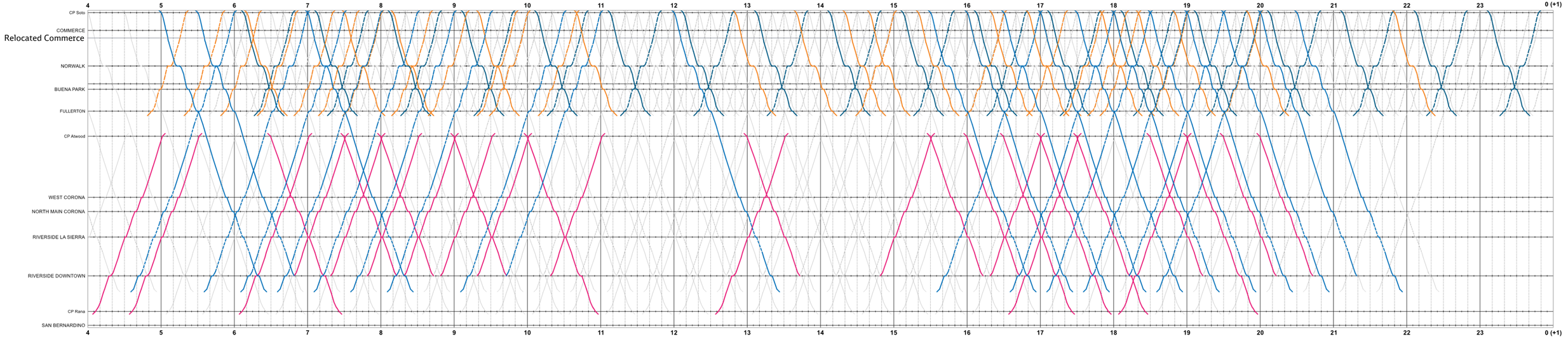
2035 Metrolink Schedule – San Bernardino Subdivision

6-Train Plan on Phase 4 infrastructure, 100% separation of passenger and freight services

Surfliner and Metrolink operate on M3 between Soto and Fullerton

Metrolink operates on M3 between Fullerton and San Bernardino

Illustrative



Service Type — Pacific Surfliner — Orange County — IEOC — 91 — Dedicated passenger track — Passenger services operating on freight tracks — Train Slot template

Disclaimer: These stringlines are based on prior Metrolink proposals rebased on to the passenger service templates. They were developed solely to inform capacity consumption calculations and should not be interpreted as final operating schedules.

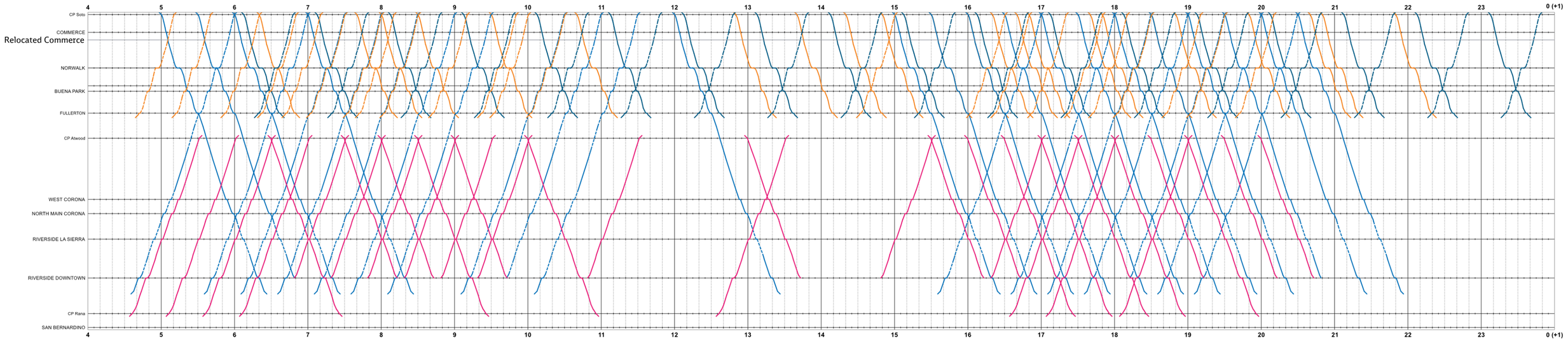
2040 Metrolink Schedule – San Bernardino Subdivision

6-Train Plan on Phase 5 infrastructure, 100% separation of passenger and freight services

Surfliner and Metrolink operate on M3 between Soto and Fullerton

Metrolink operates on M3 between Fullerton and San Bernardino

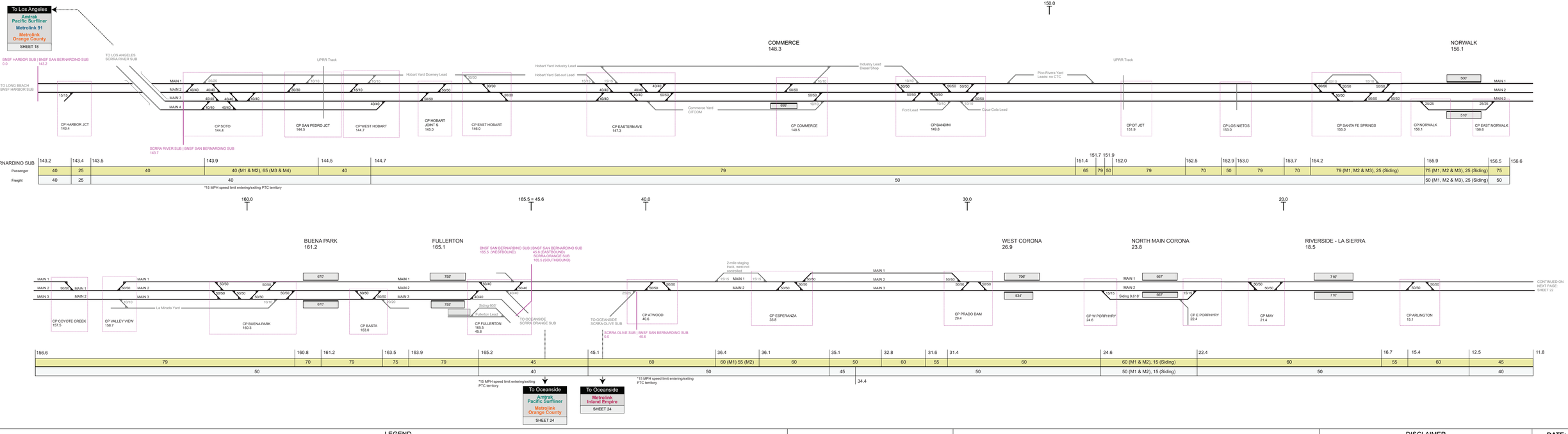
Illustrative



Service Type — Pacific Surfliner — Orange County — IEOC — 91 — Dedicated passenger track — Passenger services operating on freight tracks — Train Slot template

Disclaimer: These stringlines are based on prior Metrolink proposals rebased on to the passenger service templates. They were developed solely to inform capacity consumption calculations and should not be interpreted as final operating schedules.

DRAFT



LEGEND

- Track segment
- Track segment included as reference
- Track segment proposed for removal
- Proposed track segment
- 60/40 — Maximum turnout or crossover speed (60 mph passenger / 40 mph freight)
- 985' — Passenger platform with length (feet)
- 45/40 — AREMA speed used (passenger/freight mph)
- 79 — Passenger speed (mph)
- 79 — Freight speed (mph)
- 20.0 — Approximate mile marker
- CP HELEN 10.5 — Control point with official milepost

Current Infrastructure

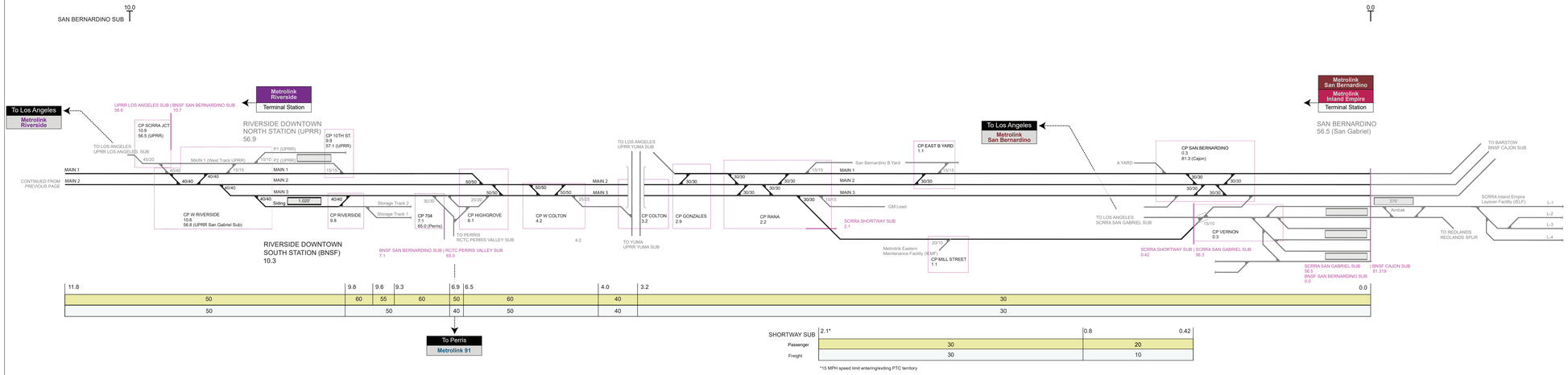
SAN BERNARDINO - SHORTWAY SUBDIVISIONS

BNSF SAN BERNARDINO SUBDIVISION (CP Soto [MP 144.4] - CP San Bernardino [MP 0.3])
SCRRA SHORTWAY SUBDIVISION (CP Rana [MP 2.2] - CP Vernon [MP 0.3])

DATE: June 20, 2019

SHEET: 1

DRAFT



11.8	9.8	9.6	9.3	6.9	6.5	4.0	3.2	0.0
50	60	55	60	50	60	40	30	
50	50			40	50	40	30	

SHORTWAY SUB	2.1*	0.8	0.42
Passenger	30		20
Freight	30		10

*15 MPH speed limit entering/exiting PTC territory

LEGEND

- Track segment
- Track segment included as reference
- Proposed new track segment
- 60/40 — Maximum turnout or crossover speed (60 mph passenger / 40 mph freight)
- 985' — Passenger platform with length (feet)
- 45/40 — AREMA speed use (passenger/freight mph)
- 79 — Passenger speed (mph)
- 79 — Freight speed (mph
- 30.0 — Approximate mile marker
- CP Helen 10.5 — Control point with official milepost

Current Infrastructure

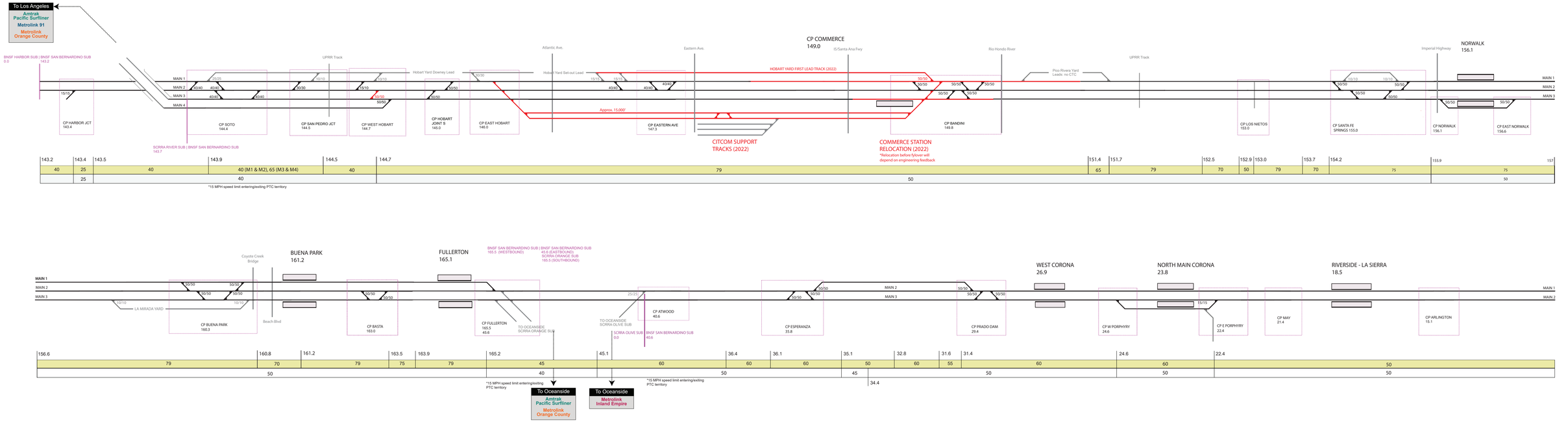
SAN BERNARDINO - SHORTWAY SUBDIVISIONS

BNSF SAN BERNARDINO SUBDIVISION (CP Soto [MP 144.4] - CP San Bernardino [MP 0.3])
SCRRA SHORTWAY SUBDIVISION (CP Rana [MP 2.2] - CP Vernon [MP 0.3])

DATE: May. 11, 2021

SHEET: 2

DRAFT



LEGEND

- Track segment
- Track segment included as reference
- Proposed new track segment
- 60/40 — Maximum turnout or crossover speed (60 mph passenger / 40 mph freight)
- 985' — Passenger platform with length (feet)
- 45/40 — AREMA speed used (passenger/freight mph)
- 79 — Passenger speed (mph)
- 79 — Freight speed (mph)
- 20.0 — Approximate mile marker
- CP HELEN 10.5 — Control point with official milepost

Phase 1

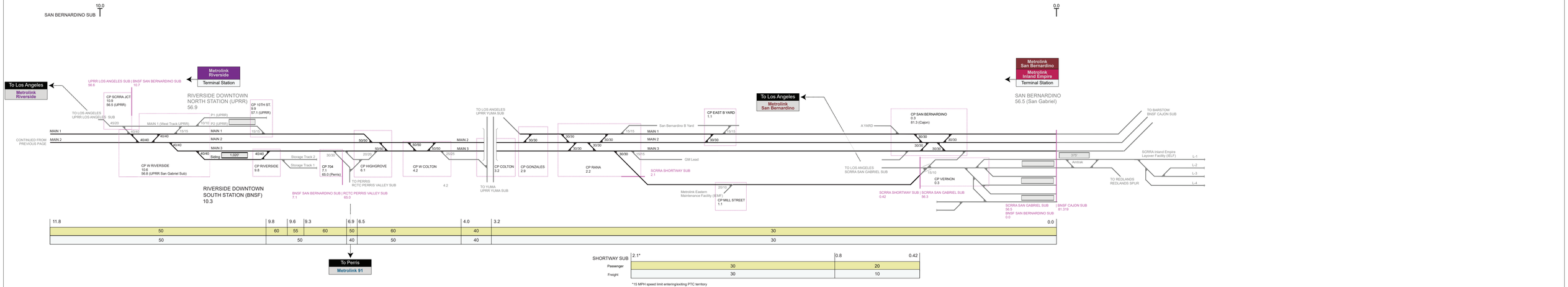
SAN BERNARDINO - SHORTWAY SUBDIVISIONS

BNSF SAN BERNARDINO SUBDIVISION (CP Soto [MP 144.4] - CP San Bernardino [MP 0.3])
SCRRA SHORTWAY SUBDIVISION (CP Rana [MP 2.2] - CP Vernon [MP 0.3])

DATE: May. 11, 2021

SHEET: 3

DRAFT



LEGEND

- Track segment
- Track segment included as reference
- Proposed new track segment
- 60/40 — Maximum turnout or crossover speed (60 mph passenger / 40 mph freight)
- 985' — Passenger platform with length (feet)
- 45/40 — AREMA speed use (passenger/freight mph)
- 79 — Passenger speed (mph)
- 79 — Freight speed (mph
- 20.0 — Approximate mile marker
- CP Helen 10.5 — Control point with official milepost

Phase 1

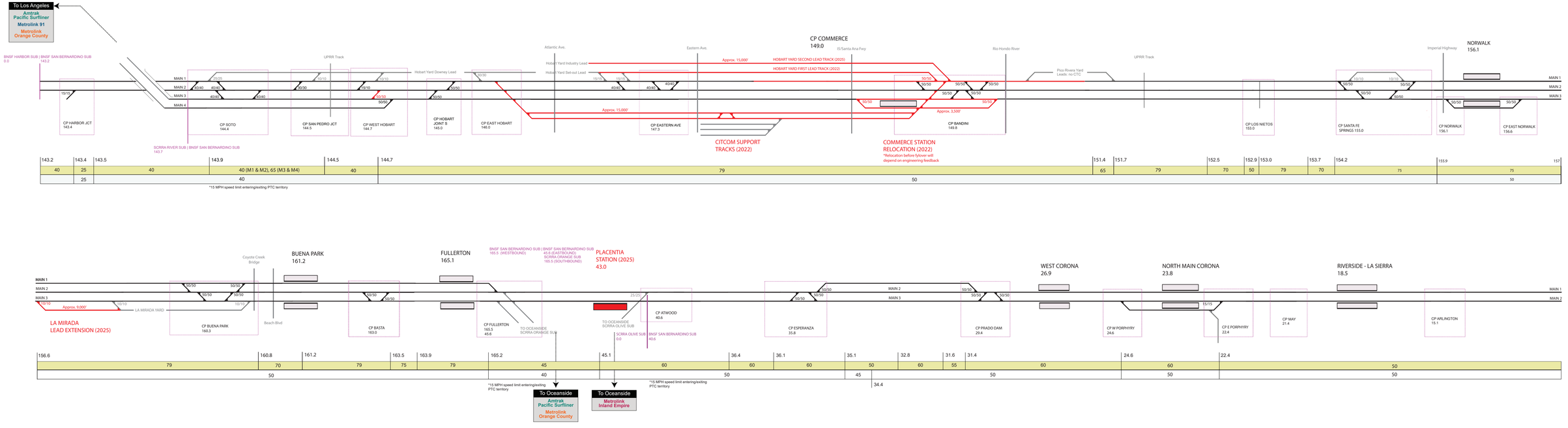
SAN BERNARDINO - SHORTWAY SUBDIVISIONS

BNSF SAN BERNARDINO SUBDIVISION (CP Soto [MP 144.4] - CP San Bernardino [MP 0.3])
SCRRA SHORTWAY SUBDIVISION (CP Rana [MP 2.2] - CP Vernon [MP 0.3])

DATE:
May. 11, 2021

SHEET:
4

DRAFT



LEGEND

- Track segment
- Track segment included as reference
- Proposed new track segment
- 60/40 — Maximum turnout or crossover speed (60 mph passenger / 40 mph freight)
- 985' — Passenger platform with length (feet)
- 45/40 — AREMA speed used (passenger/freight mph)
- 79 — Passenger speed (mph)
- 79 — Freight speed (mph)
- 20.0 — Approximate mile marker
- CP HELEN 10.5 — Control point with official milepost

Phase 2

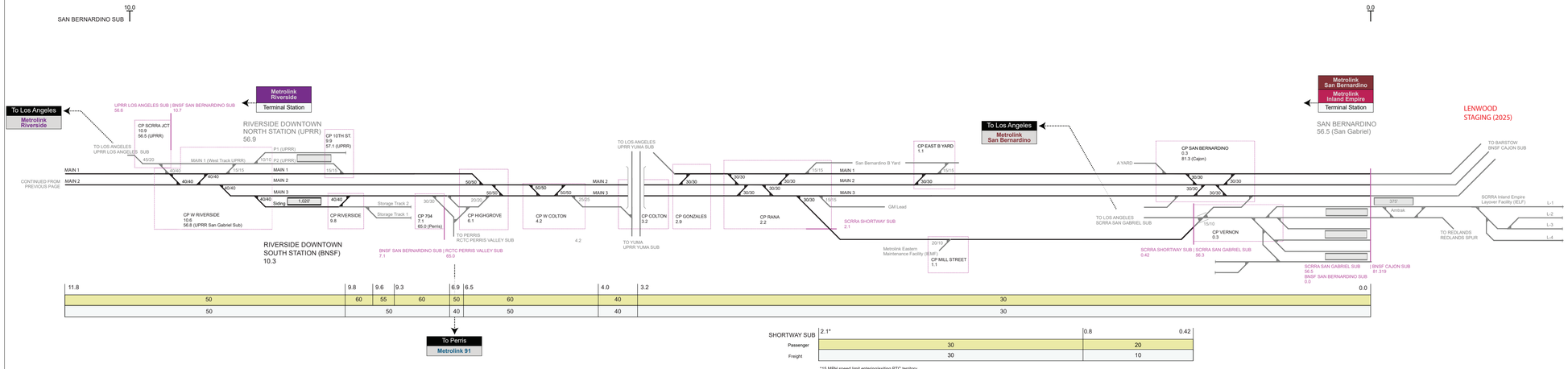
SAN BERNARDINO - SHORTWAY SUBDIVISIONS

BNSF SAN BERNARDINO SUBDIVISION (CP Soto [MP 144.4] - CP San Bernardino [MP 0.3])
SCRRA SHORTWAY SUBDIVISION (CP Rana [MP 2.2] - CP Vernon [MP 0.3])

DATE: May. 11, 2021

SHEET: 5

DRAFT



11.8	9.8	9.6	9.3	6.9	6.5	4.0	3.2	0.0
50	60	55	60	50	60	40	30	
50	50			40	50	40	30	

SHORTWAY SUB	2.1*	0.8	0.42
Passenger	30	20	
Freight	30	10	

*15 MPH speed limit entering/exiting PTC territory

LEGEND

- Track segment
- Track segment included as reference
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- 985' — Passenger platform with length (feet)
- 45/40 — AREMA speed use (passenger/freight mph)
- 79 — Passenger speed (mph)
- 79 — Freight speed (mph
- 30.0 — Approximate mile marker
- CP Helen 10.5 — Control point with official milepost

Phase 2

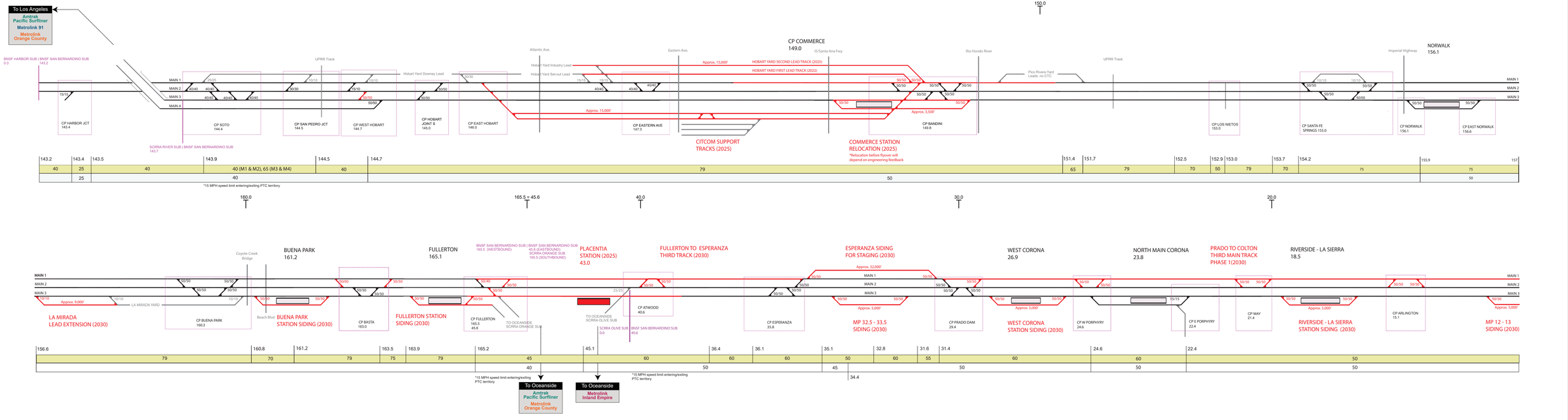
SAN BERNARDINO - SHORTWAY SUBDIVISIONS

BNSF SAN BERNARDINO SUBDIVISION (CP Soto [MP 144.4] - CP San Bernardino [MP 0.3])
SCRRA SHORTWAY SUBDIVISION (CP Rana [MP 2.2] - CP Vernon [MP 0.3])

DATE:
May. 11, 2021

SHEET:
6

DRAFT



LEGEND

- Track segment
- Track segment included as reference
- Proposed new track segment
- 60/40 — Maximum turnout or crossover speed (60 mph passenger / 40 mph freight)
- 985' — Passenger platform with length (feet)
- 45/40 — AREMA speed used (passenger/freight mph)
- 79 — Passenger speed (mph)
- 79 — Freight speed (mph)
- 20.0 — Approximate mile marker
- CP HELEN 10.5 — Control point with official milepost

Phase 3

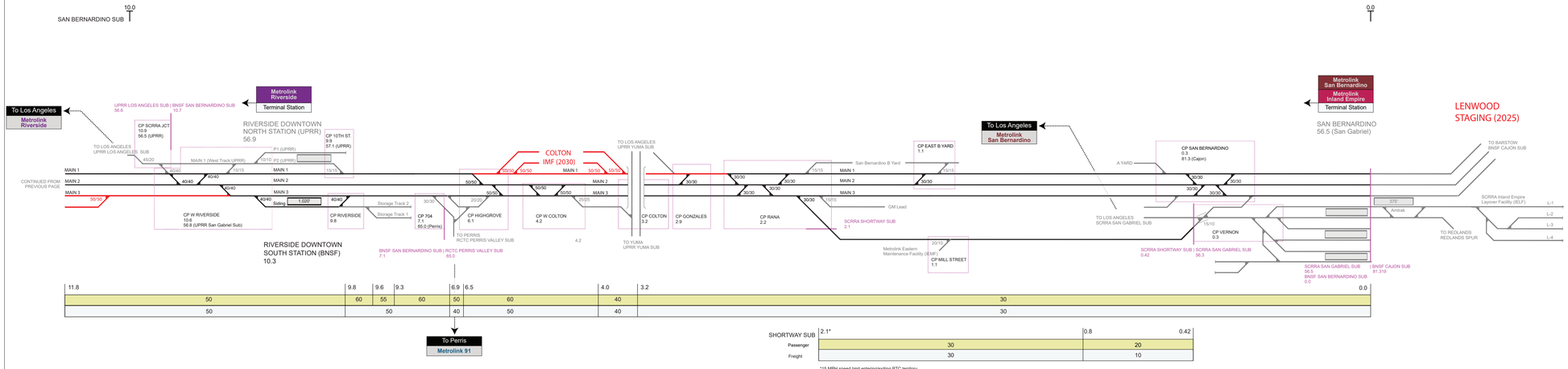
SAN BERNARDINO - SHORTWAY SUBDIVISIONS

BNSF SAN BERNARDINO SUBDIVISION (CP Soto [MP 144.4] - CP San Bernardino [MP 0.3])
SCRRA SHORTWAY SUBDIVISION (CP Rana [MP 2.2] - CP Vernon [MP 0.3])

DATE: May. 11, 2021

SHEET: 7

DRAFT



LEGEND

- Track segment
- Track segment included as reference
- Proposed new track segment
- 60/40 — Maximum turnout or crossover speed (60 mph passenger / 40 mph freight)
- 985' — Passenger platform with length (feet)
- 45/40 — AREMA speed use (passenger/freight mph)
- 79 — Passenger speed (mph)
- 79 — Freight speed (mph
- 20.0 — Approximate mile marker
- CP Helen 10.5 — Control point with official milepost

Phase 3

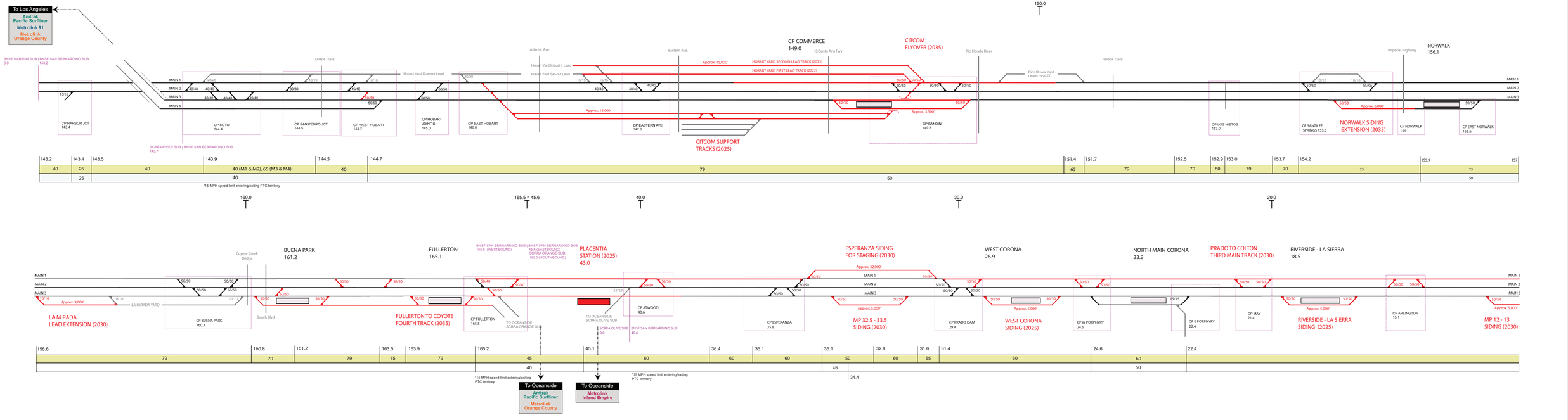
SAN BERNARDINO - SHORTWAY SUBDIVISIONS

BNSF SAN BERNARDINO SUBDIVISION (CP Soto [MP 144.4] - CP San Bernardino [MP 0.3])
SCRRA SHORTWAY SUBDIVISION (CP Rana [MP 2.2] - CP Vernon [MP 0.3])

DATE:
May. 11, 2021

SHEET:
8

DRAFT



LEGEND

- Track segment
- Track segment included as reference
- Proposed new track segment
- 60/40 — Maximum turnout or crossover speed (60 mph passenger / 40 mph freight)
- 985' — Passenger platform with length (feet)
- 45/40 — AREMA speed used (passenger/freight mph)
- 79 — Passenger speed (mph)
- 79 — Freight speed (mph)
- 20.0 — Approximate mile marker
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Phase 4

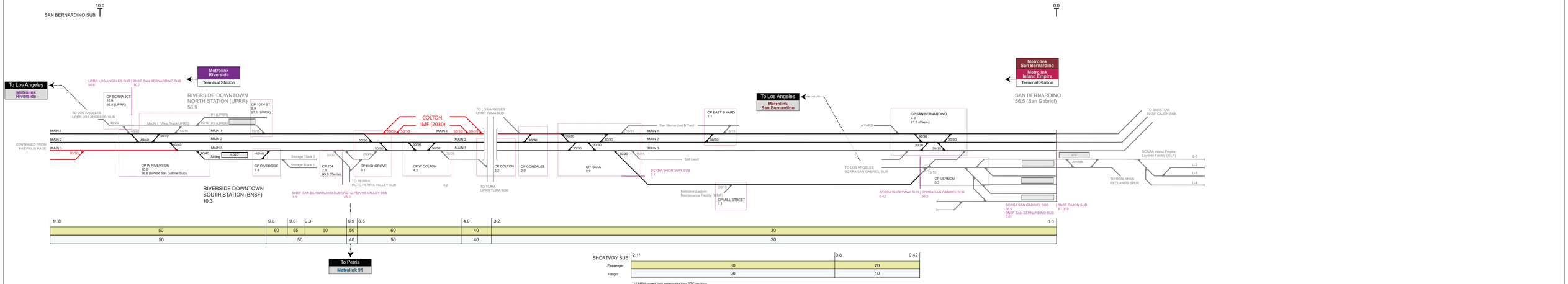
SAN BERNARDINO - SHORTWAY SUBDIVISIONS

BNSF SAN BERNARDINO SUBDIVISION (CP Soto [MP 144.4] - CP San Bernardino [MP 0.3])
SCRRA SHORTWAY SUBDIVISION (CP Rana [MP 2.2] - CP Vernon [MP 0.3])

DATE: May. 11, 2021

SHEET: 9

DRAFT



11.8	9.8	9.6	9.3	6.9	6.5	4.0	3.2	0.0
50	60	55	60	50	60	40	30	
50	50			40	50	40	30	

SHORTWAY SUB	2.1*	0.8	0.42
Passenger	30		20
Freight	30		10

*15 MPH speed limit entering/exiting PTC territory

LEGEND

- Track segment
- Track segment included as reference
- Proposed new track segment
- 60/40 — Maximum turnout or crossover speed (60 mph passenger / 40 mph freight)
- 985' — Passenger platform with length (feet)
- 45/40 — AREMA speed use (passenger/freight mph)
- 79 — Passenger speed (mph)
- 79 — Freight speed (mph
- 30.0 — Approximate mile marker
- CP Helen 10.5 — Control point with official milepost

Phase 4

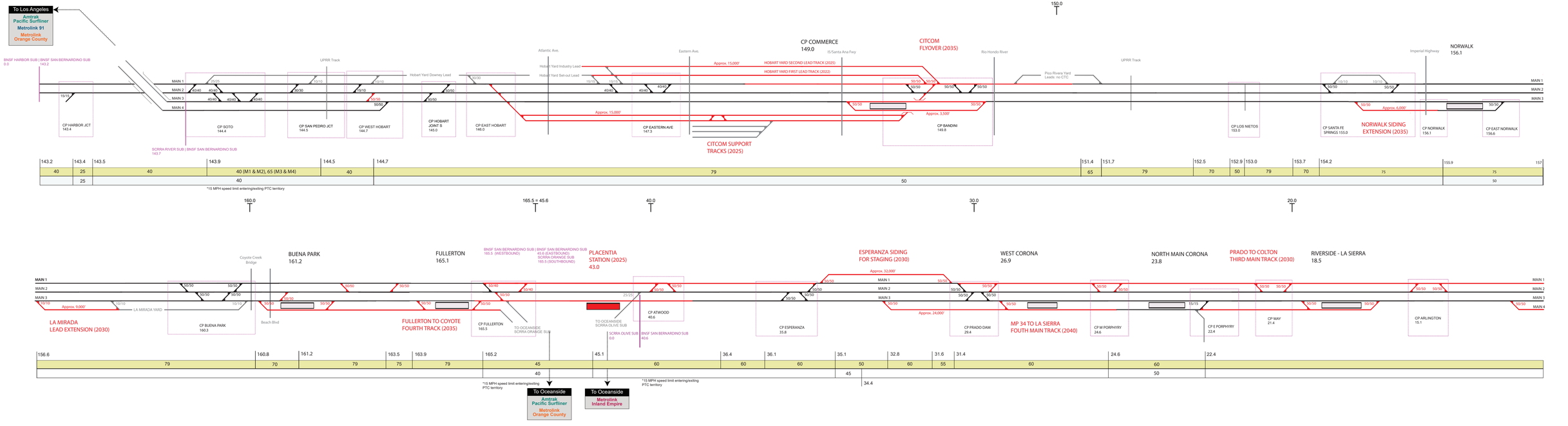
SAN BERNARDINO - SHORTWAY SUBDIVISIONS

BNSF SAN BERNARDINO SUBDIVISION (CP Soto [MP 144.4] - CP San Bernardino [MP 0.3])
SCRRA SHORTWAY SUBDIVISION (CP Rana [MP 2.2] - CP Vernon [MP 0.3])

DATE:
May. 11, 2021

SHEET:
10

DRAFT



LEGEND

- Track segment
- Track segment included as reference
- Proposed new track segment
- 60/40 — Maximum turnout or crossover speed (60 mph passenger / 40 mph freight)
- 985' — Passenger platform with length (feet)
- 45/40 — AREMA speed used (passenger/freight mph)
- 79 — Passenger speed (mph)
- 79 — Freight speed (mph)
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Phase 5

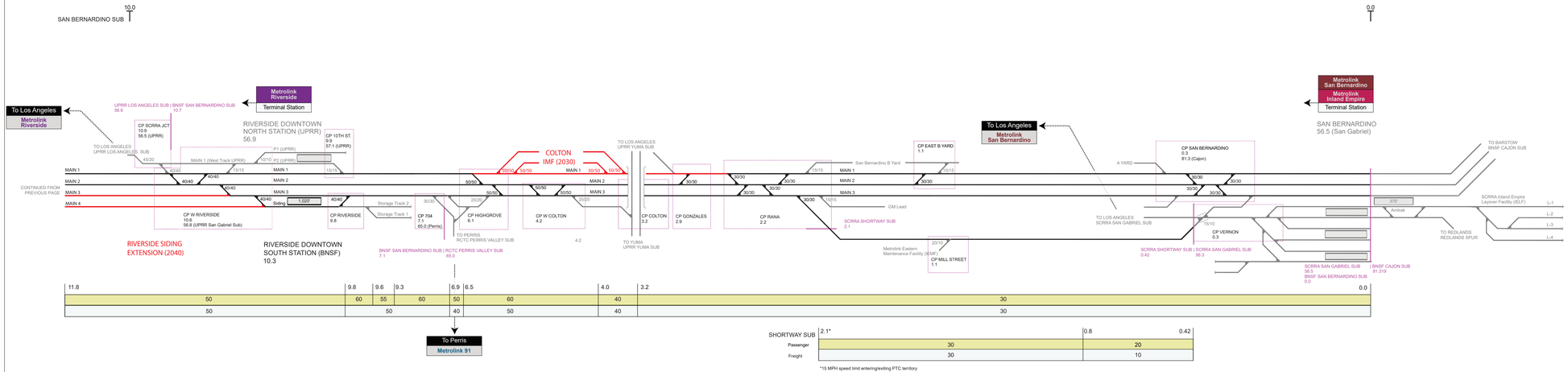
SAN BERNARDINO - SHORTWAY SUBDIVISIONS

BNSF SAN BERNARDINO SUBDIVISION (CP Soto [MP 144.4] - CP San Bernardino [MP 0.3])
SCRRA SHORTWAY SUBDIVISION (CP Rana [MP 2.2] - CP Vernon [MP 0.3])

DATE: May. 11, 2021

SHEET: 11

DRAFT



11.8	9.8	9.6	9.3	6.9	6.5	4.0	3.2	0.0
50	60	55	60	50	60	40	30	
50	50			40	50	40	30	

SHORTWAY SUB	2.1*	0.8	0.42
Passenger	30		20
Freight	30		10

*15 MPH speed limit entering/exiting PTC territory

LEGEND

- Track segment
- Track segment included as reference
- Proposed new track segment
- 60/40 Maximum turnout or crossover speed (60 mph passenger / 40 mph freight)
- 985' Passenger platform with length (feet)
- 45/40 AREMA speed use (passenger/freight mph)
- 79 Passenger speed (mph)
- 79 Freight speed (mph
- 30.0 Approximate mile marker
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Phase 5

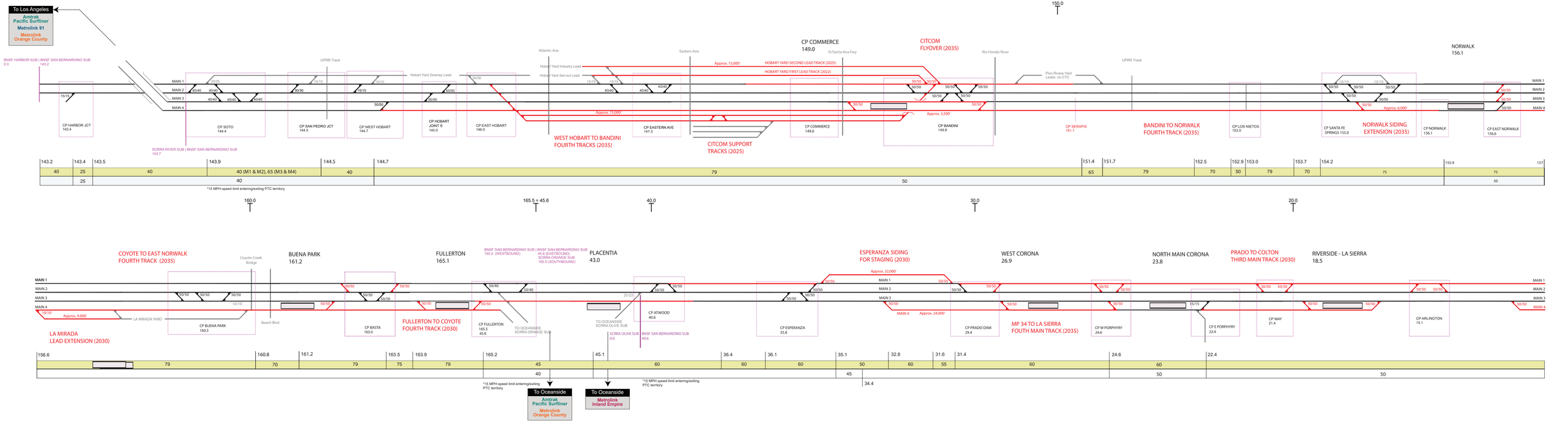
SAN BERNARDINO - SHORTWAY SUBDIVISIONS

BNSF SAN BERNARDINO SUBDIVISION (CP Soto [MP 144.4] - CP San Bernardino [MP 0.3])
SCRRA SHORTWAY SUBDIVISION (CP Rana [MP 2.2] - CP Vernon [MP 0.3])

DATE: May. 11, 2021

SHEET: 12

DRAFT



LEGEND

- Track segment
- Track segment included as reference
- Proposed new track segment
- 60/40 — Maximum turnout or crossover speed (60 mph passenger / 40 mph freight)
- 985' — Passenger platform with length (feet)
- 45/40 — AREMA speed used (passenger/freight mph)
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- 79 — Freight speed (mph)
- 20.0 — Approximate mile marker
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Full Build (HSR)

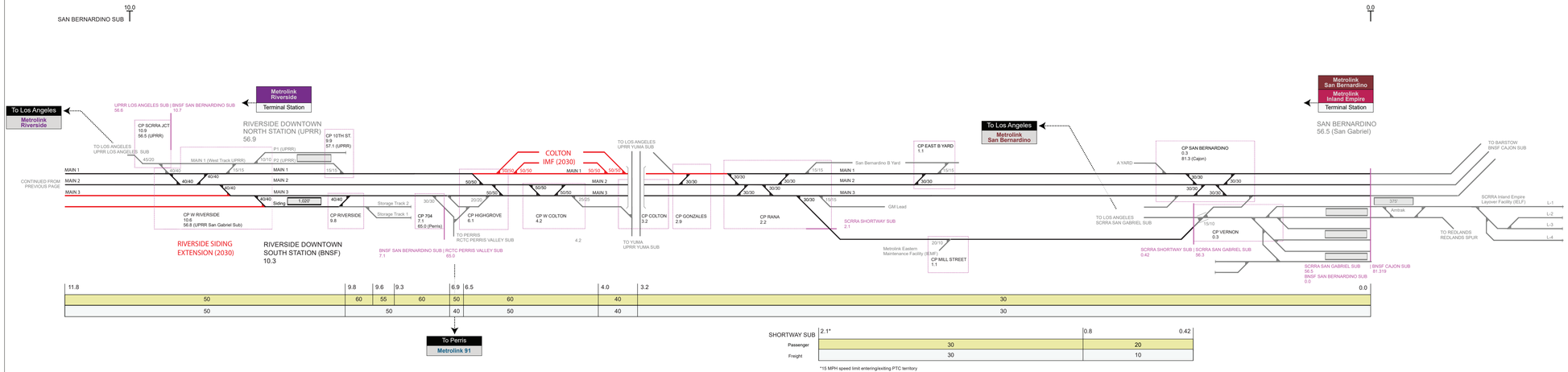
SAN BERNARDINO - SHORTWAY SUBDIVISIONS

BNSF SAN BERNARDINO SUBDIVISION (CP Soto [MP 144.4] - CP San Bernardino [MP 0.3])
SCRRA SHORTWAY SUBDIVISION (CP Rana [MP 2.2] - CP Vernon [MP 0.3])

DATE: May. 11, 2021

SHEET: 13

DRAFT



LEGEND

- Track segment
- Track segment included as reference
- Proposed new track segment
- 60/40 — Maximum turnout or crossover speed (60 mph passenger / 40 mph freight)
- 985' — Passenger platform with length (feet)
- 45/40 — AREMA speed use (passenger/freight mph)
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Full Build (HSR)

SAN BERNARDINO - SHORTWAY SUBDIVISIONS

BNSF SAN BERNARDINO SUBDIVISION (CP Soto [MP 144.4] - CP San Bernardino [MP 0.3])
SCRRA SHORTWAY SUBDIVISION (CP Rana [MP 2.2] - CP Vernon [MP 0.3])

DATE: May. 11, 2021

SHEET: 14